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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

Clemson University
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# REPORT

OF

# PROGRESS OF STREAM MEASUREMENTS

FOR

# THE CALENDAR YEAR 1904

PREPARED UNDER THE DIRECTION OF F. H. NEWELL
BY
**M. C. HINDERLIDER and JOHN C. HOYT**

PART VIII.—Platte, Kansas. Meramec, Arkansas, and Red River Drainages

WASHINGTON
GOVERNMENT PRINTING OFFICE
1905

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# LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
*Washington, D. C., April 26, 1905.*

SIR: I transmit herewith the manuscript of Part VIII of a series of twelve papers which compose the Report of Progress of Stream Measurements for the Calendar Year 1904. Parts I to VI of this report contain the results of the data collected in the territory east of Mississippi River. Parts VII to XII are devoted to the data collected in the territory west of Mississippi River.

The larger part of the original data for this report was collected under the direction of district hydrographer M. C. Hinderlider, who was assisted by Messrs. R. I. Meeker, J. C. Stevens, A. J. Parshall, W. G. Russell, and F. M. Madden. A limited amount of the data was collected by other parties as noted in the list of acknowledgments. The assembling of the data and its preparation for publication were done under the direction of John C. Hoyt, who has been assisted by R. H. Bolster, Robert Follansbee, Willis E. Hall, A. H. Horton, H. D. Comstock, F. H. Tillinghast, and H. M. Morse.

I request that this manuscript be published as one of the series of Water-Supply and Irrigation Papers.

Very respectfully,

F. H. NEWELL,
*Chief Engineer.*

HON. CHARLES D. WALCOTT,
*Director United States Geological Survey.*

# PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1904.

## PART VIII.

By M. C. Hinderlider and John C. Hoyt.

### INTRODUCTION.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. Since that date the work has been continually and gradually extended as larger funds became available. The first distinctive appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500, "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Digest of Appropriations for 1895, p. 270.)

Since that time a similar act has been passed each year and the appropriations have gradually increased, as shown in the following table:

*Annual appropriations for hydrographic surveys.*

| | |
|---|---|
| Year ending June 30, 1895 | $12,500 |
| Year ending June 30, 1896 | 25,000 |
| Year ending June 30, 1897 | 50,000 |
| Year ending June 30, 1898 | 50,000 |
| Year ending June 30, 1899 | 50,000 |
| Year ending June 30, 1900 | 50,000 |
| Year ending June 30, 1901 | 100,000 |
| Year ending June 30, 1902 | 100,000 |
| Year ending June 30, 1903 | 200,000 |
| Year ending June 30, 1904 | 200,000 |
| Year ending June 30, 1905 | 200,000 |
| Year ending June 30, 1906 | 200,000 |

The chief feature of the work of the hydrographic division is the systematic study of the flow of the surface waters and the conditions affecting the same. In this connection other information that may be of use to the engineer or others in hydrographic studies, such as river profiles, duration and extent of damage by floods, water-power data, etc., is collected. Furthermore, the work has been so directed that the information collected will be of direct value in the commercial and agricultural development of the country.

As a result of the increased appropriations since June 30, 1902, the work has been largely extended and thoroughly systemized. The various States have been grouped into districts, each of which is under the supervision of a district hydrographer who, with a corps of assistants, devotes his whole time to the study of the hydrographic resources of his district.

The methods used in the collection of these data and in their preparation for publication are given in detail in Water-Supply Paper No. 94. (Hydrographic Manual, U. S. Geol. Survey.)

The general plan of stream gaging which has been developed is to obtain eventually data in regard to the flow of all the important streams in the United States. With this in view, gaging stations are established at points where the data will be of greatest commercial value. At these stations discharge measurements are taken from time to time at typical river stages, and the daily surface fluctuation is obtained by means of gage reading. From these two factors it is possible to estimate both the total flow and its distribution through the period of observation.

The selection of the site for a gaging station and the length of time the station is maintained depend largely upon the needs of each locality. If the stream is to be used for water power, special efforts are made to obtain information concerning the low-water flow. If water is to be stored, the high waters are given special attention. In all sections certain permanent stations are maintained for general statistical purposes to show the conditions which exist through long periods. They also act as primary stations, and are used in connection with short series of measurements to determine the flow in particular portions of the drainage basin.

Gaging stations are divided into two general classes: First, current-meter stations, and, second, weir stations. The former class is subdivided as to location into bridge, cable, boat, and wading stations. Fig. 1 shows a cable station with car, tag line, inclined gage, etc. In addition to the bridge, cable, or boat, the equipment of a current-meter gaging station consists in a gage for determining the daily fluctuations of the water surface, bench marks to which the zero of the gage is referred, and permanent marks on the bridge or a tagged line indicating the points of measurement. Where the current is

MAP OF THE UNITED STATES, SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 1904.

swift some appliance, generally a secondary cable, is necessary to hold the meter below the surface.

Gaging stations are generally located at bridges, if the channel conditions are satisfactory, as from them the meter can be easily manipulated, and the cost of the equipment is comparatively small. The stations are located as far as possible at points where the channel is straight, both above and below the gaging section, and where there are no cross currents, backwater, or boils. The bed of the stream should be as clear as possible from large projections and of a permanent character. The banks should be high, and should overflow at high stages only. At stations with shifting beds more measurements are made, and special methods of computing daily discharges are employed. Great care is taken in the selection and equipment of gaging stations in order that the data may have the required degree of accuracy.

On many of the larger rivers, where water power is developed by dams, estimates of flow are obtained by observing the head on the

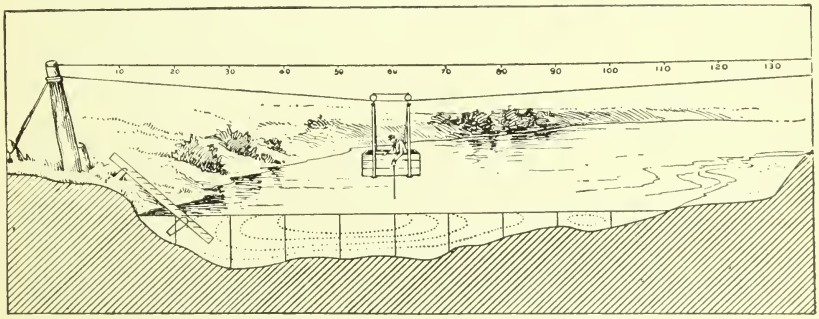



FIG. 1.—Cable station, showing section of river, car, gage, etc,

crest and using a weir formula. On the smaller streams sharp-crested weirs are in some cases erected.

The principal instrument used in stream-measurement work is the current meter, by which the velocity of the flow of water is determined. After years of experience the Survey has adopted the Price current meter for general work. This meter, as is shown on Pl. II, is made in two sizes, known as the large and small Price. The small Price has been largely developed by the officers of the Survey, using the Price acoustic meter as a basis.

A discharge measurement is the determination of the quantity of water flowing past a certain point at a given time. This quantity is the product of two factors: (1) The mean velocity, which is the function of the cross section, surface slope, wetted perimeter, and roughness of bed; (2) the area, which depends upon the permanency of the bed and the fluctuations of the surface, which govern the depth.

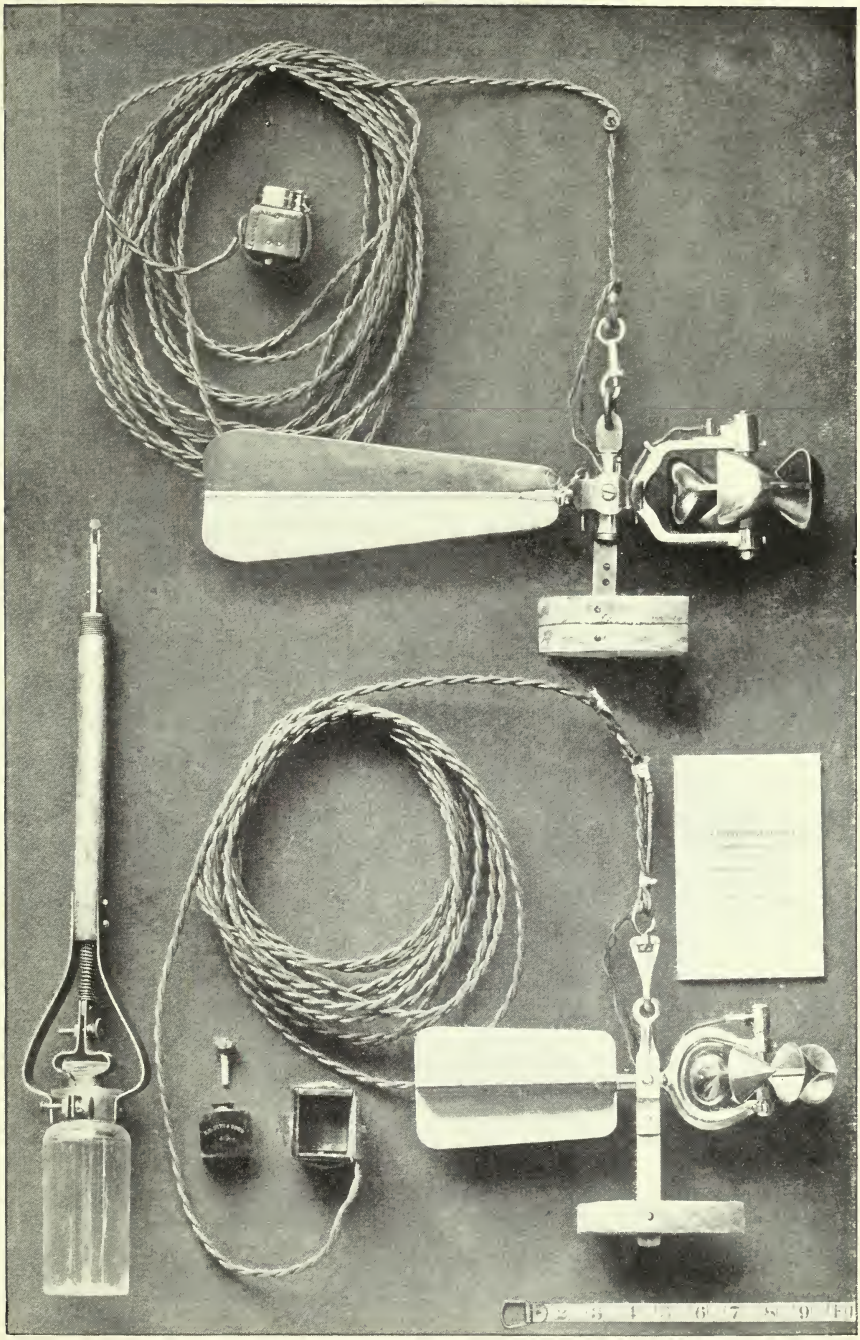
In making the measurement an arbitrary number of points are laid off perpendicular to the thread of the stream (see fig. 1). These points

are usually at regular intervals varying from 2 to 20 feet, depending upon the size and conditions of the stream. They are known as measuring points, and at them the observed data, the velocities and soundings, are taken. The perpendiculars dropped from the measuring points divide the gaging section into strips, and for each strip or pair of strips the mean velocity, area, and discharge are determined independently; thus conditions existing in one part of the stream are not distributed to parts where they do not apply.

The methods of obtaining velocity with the current meters which are in general use may be grouped into three classes: Single point, multiple point, and integration.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined. Extensive experiments by vertical velocity-curves show that the thread of mean velocity lies at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and it is at this depth that the meter is held in the majority of the measurements, this being known as the six-tenth depth method. It is found by a large number of vertical velocity-curve measurements, taken on various streams and under various conditions, that the coefficient for reducing the velocity obtained at six-tenths depth to mean velocity is practically unity, ranging, in a series of 910 measurements made at 39 gaging stations, between .94 and 1.04, with a mean for the 910 observations of 1.00. In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the action of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocities taken at the subsurface has been found by repeated experiments with vertical velocity-curves to be from .85 to .95, depending upon the depth of the stream and velocity and channel conditions. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The three principal multiple-point methods in general use are: The vertical velocity curve; top and bottom; and top, bottom, and mid depth. In the vertical velocity-curve method a series of velocity determinations are taken in the vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve through these points, the vertical velocity-curve is produced, which shows the change in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the depth into the area bounded by this mean velocity curve and the initial line. Owing to the length of time it takes to make these measurements they



PRICE CURRENT METERS, WITH BUZZERS.

are seldom used except for determining coefficients for purposes of comparison and for measurements under ice.

In the second multiple-point method the meter is held from 0.5 to 1 foot below the surface and about 0.5 foot above the bottom, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is not well adapted for general work, as the roughness of the bottom disturbs the velocity at that point. For shallow streams with comparatively smooth beds good results are obtained by this method. In the third multiple-point method the meter is held at mid depth, 0.5 foot below the surface, and 0.5 foot above the bottom, and the mean velocity is determined by dividing the sum of the top velocity, twice the mid-depth velocity, and the bottom velocity by 4.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface. The number of revolutions and the time taken in the operation is noted, and the mean velocity is found by dividing the number of revolutions by the number of seconds taken in the run. This method has the advantage in that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor for determining the discharge of the stream, depends upon the stage of the river, which is taken on a gage, and the general contour of the bed of the stream, which is found by sounding. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For stations with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also used for obtaining the area for use in high-water measurement computations, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at the various points of measurements the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-

feet," "acre-feet," "run-off per square mile," and "run-off in depth in inches," and may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of 1 foot. There is a convenient relation between the second-foot and the acre-foot; 1 second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, which equals 1.9835 acre-feet, or, approximately, 2 acre-feet.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area, on the assumption that the run-off is uniformly distributed.

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet" and "depth in inches" represent the actual quantities of water which are produced during the periods in question, while "second-feet," on the contrary, is merely a rate of flow per second.

The base data for computing the daily discharge of a stream are the daily gage heights and the various discharge measurements, of which there should be sufficient number to cover the range of stage. The fundamental laws upon which these computations are based are the following:

(1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant;

(2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; and

(3) The discharge is both a function of, and increases gradually with, the gage heights. (2 and 3 depend on 1.)

As the beds of many streams are changeable, the problem divides itself into two classes: (1) Those of streams with permanent, or practically permanent beds, and (2) those of streams with changeable beds. The base data and methods of obtaining them are the same for either class, and it is only in the computation of the mean daily flow that different methods are necessary.

In determining the daily discharge of streams with permanent beds the results of the discharge measurements are plotted on cross-section

paper, with gage heights as ordinates and discharges as abscissas. Through these points a smooth curve is drawn, which shows the discharge for any gage height, and from which a rating table is prepared. Aside from plotting the discharge, the mean velocity and area determined for each discharge measurement are plotted. Through these points the curves of mean velocity and of area are drawn, and the rating curve is largely determined by taking the product of the mean velocity and the area at various stages as determined by these curves. These curves of mean velocity and area are of special value to determine the location of the rating curve for stages at which actual discharge measurements are not available and for extending the discharge curve outside the limits of the measurements. In the preparation of the rating table the discharge for each tenth or half tenth on the gage is found from the curve. The first and second differences of these discharges are then taken and adjusted according to the law that they shall either be constant or increasing, never decreasing. The discharges in the table are then changed in accordance with these adjusted differences. In making up the station-rating curve the individual discharge measurements and the conditions under which they were taken are carefully studied, in order that proper weight shall be given to each measurement. Rating curves in general take the form of a parabola, and as a rule the high-water portion of the curve approaches a straight line. For stations of permanent character the results of the measurements from year to year should be within 5 per cent of the curve, with the exception of those taken during high water, when the probable error may be as high as 10 per cent.

The determination of the daily discharge of streams with changeable beds is difficult, and unless frequent discharge measurements are made the results obtained are only roughly approximate. For streams with continually shifting beds, such as Colorado River and the Rio Grande, discharge measurements are made every two or three days, and the discharges for the intervening days are obtained by interpolation, modified by the gage heights for these days. For stations with beds which shift slowly, or are only materially changed during floods, station-rating curves and tables can be prepared for the periods between changes, and satisfactory results can be obtained with two or three measurements a month, providing measurements are taken soon after the changes take place.

In determining the flow for periods when the streams are frozen, special rating curves and tables have to be prepared from measurements taken under these conditions. The methods of constructing these curves and tables are the same as for open sections. The discharge measurements, however, are either taken by integration in verticals or by the vertical velocity-curve method, as sufficient experi-

ments have not been made on ice-covered streams to determine the laws which govern the position of the thread of mean velocity.

The Report of Progress of Stream Measurements for the Calendar Year 1904, of which this is Part VIII, is published in a series of twelve Water-Supply Papers, Nos. 124–135, inclusive, under the following subtitles:

Part 1. Atlantic coast of New England drainage.

Part 2. Hudson, Passaic, Raritan, and Delaware River drainage.

Part 3. Susquehanna, Patapsco, Potomac, James, Roanoke, Cape Fear, and Yadkin River drainages.

Part 4. Santee, Savannah, Ogeechee, Altamaha rivers, and Eastern Gulf of Mexico drainage.

Part 5. Eastern Mississippi River drainage.

Part 6. Great Lakes and St. Lawrence River drainage.

Part 7. Hudson Bay, Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River drainages.

Part 8. Platte, Kansas, Meramec, Arkansas, and Red River drainages.

Part 9. Western Gulf of Mexico drainage.

Part 10. Colorado River and the Great Basin drainages.

Part 11. The Great Basin and Pacific Ocean drainages in California.

Part 12. Columbia River and Puget Sound drainage.

The territory covered by each paper is given in the subtitle, and the larger drainages are, for convenience in arrangement, subdivided into smaller ones, under which the data are arranged, as far as practicable, geographically.

These papers contain the data that have been collected at the regular gaging stations, the results of the computations based upon the observations, and such other information that has been collected, that has a direct bearing on these data, including, as far as practicable, descriptions of the drainage areas and the streams draining them.

For each regular station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off.

The descriptions of stations give, as far as possible, such general facts about the locality and equipment as would enable the reader to find the station and use the same. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year. This includes the date, the hydrographer's name, the gage height, and the discharge in second-feet.

The table of daily gage heights gives for each day the mean height of the surface of the river as found from the mean of the gage readings taken on that day. At most of the stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated run-off the column headed "Maximum" gives the mean flow for the day when the mean gage height was the highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" gives the average flow for each second during the month. Upon this mean the computations for the three remaining columns which are defined on page 14 are based.

In the computations for the tables of this report the following rules have been used in general:

*Fundamental rules for computation.*

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should in general be expressed by at least two and by not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

5. In constructing and applying rating tables a maximum limit of one-half per cent error should seldom be exceeded.

*Special rules for computation.*

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out at least to three significant figures, except in the case of decimals, where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following Survey publications. A detailed index of these reports (1888–1903) is given in Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124 to 129, inclusive.
West of Mississippi River, Water-Supply Papers Nos. 130 to 135, inclusive.

A limited number of these are for free distribution, and as long as the supply lasts they may be obtained by application to the Director United States Geological Survey or to members of Congress. Other copies are filed with the Superintendent of Public Documents, Washington, D. C., from whom they may be had at prices little above cost. Copies of Government publications are, as a rule, furnished to the public libraries in our large cities, where they may be consulted by those interested.

## COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

*Arkansas.*—District hydrographer, M. R. Hall.[a]

*Colorado.*—District and resident hydrographer, M. C. Hinderlider,[b] assisted by R. I. Meeker, assistant engineer; Oro McDermith, Wm. A. Lamb, George B. Monk, and L. E. Foster, hydrographers; and Melvin Beeson, Thomas E. Brick, Theodore Tobish, and F. L. Meeker, office assistants. Acknowledgments are due the Denver and Rio Grande, Colorado and Southern, Burlington and Missouri River, Union Pacific, Rio Grande Southern, and Atchison, Topeka and Santa Fe railroads for free transportation for hydrographers over their lines.

*Kansas.*—District hydrographer, M. C. Hinderlider, and resident hydrographer, W. G. Russell. Acknowledgments are due the Atchison, Topeka and Santa Fe, Union Pacific, Missouri, Kansas and Texas, and Chicago, Rock Island and Pacific railway companies for annual passes issued to Mr. Russell.

*Missouri.*—District hydrographer, E. Johnson, jr.,[c] assisted by F. W. Hanna, assistant engineer. Acknowledgment should be made to the St. Louis and San Francisco Railroad for transportation furnished to Mr. Hanna between St. Louis and Arlington, Mo., and to George B. Mainprize for voluntary observations at Greer Springs, Greer, Mo.

*Nebraska.*—District hydrographer, M. C. Hinderlider, and resident hydrographer, J. C. Stevens. Valuable assistance was rendered by Prof. O. V. P. Stout, of the University of Nebraska, in the way of the free use by the resident hydrographer of office facilities and suggestions in the methods for the collection of field data. Acknowledgments are also due the Chicago, Burlington and Quincy, Chicago and Northwestern, and Fremont, Elkhorn and Missouri Valley railroads for annual passes issued in favor of Mr. Stevens.

*New Mexico.*—The hydrographic work in the northern portion of this Territory was carried on under the direction of District Hydrographer M. C. Hinderlider, assisted as follows: The work in the north central portion was in charge of George B. Monk, assistant hydrographer; that in the extreme eastern portion was in charge of W. G. Russell, while the work in the northwestern portion was in charge of Robert C. Prewitt, field assistant. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on the Mora River acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of Lacueva, N. Mex.; also to James D. Hand, of Las Alamos, N. Mex., for similar favors. Transportation in the form of an annual pass was furnished Mr. Monk by the Denver and Rio Grande Railroad and to W. G. Russell by the Chicago, Rock Island and El Paso Railroad. For the purpose of collecting data in New Mexico during the later part of the year an annual pass over the Atchison, Topeka and Santa Fe Railway was issued to George B. Monk, for which acknowledgments are due.

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[a] District hydrographer for Arkansas for 1905, T. U. Taylor, Austin, Tex.

[b] Office of district hydrographer for Colorado, Kansas, Nebraska, New Mexico, Oklahoma and Indian Territories, and Wyoming, Chamber of Commerce Building, Denver, Colo.

[c] Office of district hydrographer for Missouri, 876 Federal Building, Chicago, Ill.

*Oklahoma and Indian Territories.*—The hydrographic work in the southern part of Oklahoma was carried on under the direction of G. H. Matthes, district engineer. The remainder of the work was carried on under district hydrographer M. C. Hinderlider by resident hydrographer, W. G. Russell. Acknowledgments are due the Atchison, Topeka and Santa Fe, Missouri, Kansas and Texas, and Chicago, Rock Island and Pacific railway companies for annual passes issued to Mr. Russell.

*Wyoming.*—The hydrographic work in this State has been carried on under the direction of the district hydrographer, M. C. Hinderlider, by the resident hydrographer, A. J. Parshall. Acknowledgments are due for annual passes over all their lines in Wyoming to the Union Pacific, Chicago, Burlington and Quincy, Colorado and Southern, Colorado and Wyoming, and Fremont, Elkhorn and Missouri Valley railroads.

## PLATTE RIVER DRAINAGE BASIN.

Platte River, one of the largest tributaries of the Missouri, is formed by the junction of North Platte and South Platte rivers in Lincoln County, Nebr., and flows east into Missouri River 18 miles south of Omaha, Nebr. The principal tributaries of the Platte in Nebraska are Elkhorn and Loup rivers. Elkhorn River rises in the northern part of Nebraska and flows southeast into the Platte about 35 miles above its mouth. North Loup, Middle Loup, and South Loup rivers, with their tributaries, drain north-central Nebraska and join Platte River near Columbus, Nebr.

North Platte River rises in northern Colorado, flows north into Wyoming, and then east into Nebraska. Sweetwater and Laramie rivers are its principal tributaries. The Sweetwater joins it from the west in south-central Wyoming. Laramie River rises in the northern part of Colorado and flows north into the North Platte in eastern Wyoming. The Little Laramie is a small tributary of Laramie River in southern Wyoming.

South Platte River rises in central Colorado, flows north, then east to its junction with North Platte River. Its tributaries are mostly small creeks. Big Thompson Creek joins it 8 miles south of Greeley, Colo. St. Vrain Creek joins it about 15 miles south of Greeley. Cache la Poudre River joins it 6 miles east of Greeley. Clear Creek joins it about 3 miles north of Denver and Bear Creek 8 miles south of Denver.

The following pages contain the results of data collected in the Platte River drainage basin during 1904:

### NORTH PLATTE RIVER NEAR HEBRON, COLO.

This station was established May 13, 1904, by M. C. Hinderlider. It is located at the highway bridge below the junction of Big Grizzly and Little Grizzly creeks, about 4 miles northwest of Hebron, Colo. A plain vertical staff gage, graduated to feet and tenths, is fastened to the northeast corner of the first pier from the left bank. It is read once each day by J. E. Mallon. Discharge measurements are made

from the downstream side of the three-span bridge to which the gage is attached, sounding points being marked on the hub rail every 4 feet from zero to 108 feet. The initial point for soundings is the inner face of the left abutment, marked zero on the hub rail downstream side of bridge. The bridge lies in a curve in the river of about 150 feet radius. The current is uniform and of moderate swiftness. Both banks are about 5 feet high, lined with willows, and are not liable to overflow. Below the bridge the left bank becomes a high sandstone cliff. The bed of the stream is composed of gravel, sand, and small cobblestones. It is uniform, free from vegetation, and is permanent. There is but one channel at all stages, broken by two log crib piers. The bridge is at almost right angles to the current. Bench mark No. 1 is a nail driven flush with the top of the cap timber on the west side of the crib pier to which the gage is fastened just across the pier from the gage. Its elevation is 9.445 feet above the zero of the gage. Bench mark No. 2 is a cross cut on a ledge of rock in the cliff on the left bank of the river about 50 feet north of the west end of the bridge and marked "B. M." Its elevation is 17.805 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of North Platte River near Hebron, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 13 | W. A. Lamb | 100 | 289 | 1.40 | 5.15 | 405 |
| May 26 | do | 85 | 425 | 2.78 | 6.85 | 1,180 |
| June 4 | do | 88 | 402 | 2.35 | 6.45 | 946 |
| June 27 | do | 81 | 305 | 1.56 | 5.48 | 477 |
| July 12 | do | 64 | 75 | 2.12 | 4.37 | 159 |
| August 8 | do | 52 | 28 | 2.36 | 3.80 | 66 |
| September 12 | do | 38 | 32 | 1.00 | 3.56 | 32 |

*Mean daily gage height, in feet, of North Platte River near Hebron, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 6.30 | 5.20 | 4.00 | 4.00 | 3.75 |
| 2 | ..... | 6.10 | 5.20 | 3.95 | 3.95 | 3.70 |
| 3 | ..... | 6.45 | 5.10 | 3.90 | 3.95 | 3.70 |
| 4 | ..... | 6.30 | 4.90 | 3.90 | 3.90 | 3.70 |
| 5 | ..... | 5.70 | 4.70 | 3.85 | 3.80 | 3.70 |
| 6 | ..... | 5.40 | 4.60 | 3.80 | 3.75 | 3.65 |
| 7 | ..... | 5.30 | 4.55 | 3.80 | 3.75 | 3.65 |
| 8 | ..... | 5.80 | 4.50 | 3.80 | 3.65 | 3.80 |
| 9 | ..... | 6.20 | 4.50 | 3.75 | 3.65 | 3.80 |
| 10 | ..... | 6.30 | 4.40 | 3.75 | 3.60 | 3.80 |
| 11 | ..... | 6.50 | 4.50 | 3.75 | 3.60 | 3.80 |
| 12 | ..... | 6.65 | 4.35 | 4.00 | 3.55 | 3.80 |
| 13 | 5.15 | 6.80 | 4.25 | 4.50 | 3.55 | 3.75 |
| 14 | 5.25 | 6.75 | 4.20 | 4.00 | 3.50 | 3.75 |
| 15 | 5.30 | 6.60 | 4.10 | 4.05 | 3.50 | 3.75 |
| 16 | 5.40 | 6.55 | 4.10 | 3.95 | 3.45 | 3.75 |
| 17 | 5.20 | 6.30 | 4.05 | 4.20 | 3.45 | 3.75 |
| 18 | 5.35 | 6.15 | 4.05 | 4.30 | 3.40 | 3.75 |
| 19 | 5.55 | 6.20 | 4.05 | 4.20 | 3.40 | 3.75 |
| 20 | 5.95 | 6.20 | 4.05 | 4.10 | 3.45 | 3.80 |
| 21 | 6.25 | 6.25 | 4.05 | 4.10 | 3.45 | 3.80 |
| 22 | 6.35 | 6.15 | 4.05 | 4.10 | 3.40 | 3.80 |
| 23 | 6.60 | 5.80 | 4.00 | 4.10 | 3.40 | 3.80 |
| 24 | 6.90 | 5.95 | 4.05 | 4.00 | 3.40 | 3.75 |
| 25 | 7.00 | 5.60 | 4.00 | 4.00 | 3.40 | 3.75 |
| 26 | 6.85 | 5.50 | 4.00 | 3.95 | 3.50 | 3.70 |
| 27 | 6.70 | 5.50 | 4.00 | 3.90 | 3.50 | 3.70 |
| 28 | 6.20 | 5.30 | 4.00 | 3.90 | 3.50 | 3.65 |
| 29 | 6.25 | 5.20 | 4.20 | 3.90 | 3.55 | 3.70 |
| 30 | 6.50 | 5.20 | 4.10 | 3.85 | 3.70 | 3.65 |
| 31 | 6.60 | ..... | 4.00 | 3.85 | ..... | 3.65 |

*Rating table for North Platte River near Hebron, Colo., from May 13 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.40 | 25 | 3.95 | 84 | 5.00 | 318 | 6.10 | 744 |
| 3.45 | 29 | 4.00 | 92 | 5.10 | 350 | 6.20 | 792 |
| 3.50 | 33 | 4.10 | 109 | 5.20 | 384 | 6.30 | 844 |
| 3.55 | 38 | 4.20 | 128 | 5.30 | 420 | 6.40 | 900 |
| 3.60 | 43 | 4.30 | 148 | 5.40 | 458 | 6.50 | 958 |
| 3.65 | 48 | 4.40 | 168 | 5.50 | 498 | 6.60 | 1,018 |
| 3.70 | 53 | 4.50 | 188 | 5.60 | 538 | 6.70 | 1,082 |
| 3.75 | 58 | 4.60 | 210 | 5.70 | 578 | 6.80 | 1,146 |
| 3.80 | 64 | 4.70 | 234 | 5.80 | 618 | 6.90 | 1,212 |
| 3.85 | 70 | 4.80 | 260 | 5.90 | 658 | 7.00 | 1,280 |
| 3.90 | 77 | 4.90 | 288 | 6.00 | 700 | | |

The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1904, and is well defined.

*Estimated monthly discharge of North Platte River near Hebron, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 13–31 | 1,280 | 367 | 774 | 29,170 |
| June | 1,146 | 384 | 738 | 43,910 |
| July | 384 | 92 | 158 | 9,715 |
| August | 188 | 58 | 90.4 | 5,558 |
| September | 92 | 25 | 43.2 | 2,571 |
| October | 64 | 48 | 57.0 | 3,505 |
| The period | | | | 94,430 |

NORTH PLATTE RIVER (NORTH FORK) AT HIGHO, COLO.

This station was established May 14, 1904, by M. C. Hinderlider. It is located at the footbridge at Higho post-office, 7 miles northwest of Hebron and 12 miles west of Walden, Colo. A plain, vertical staff gage is spiked to the southwest face of the left abutment on the downstream side. It is read twice each day by Mrs. Esther Bergquist. Discharge measurements are made at low stages by wading near the gage, and at high water from the single-span footbridge to which the gage is attached. The initial point for soundings is a nail driven into the walk log at the left end of the bridge. The channel is straight for about 150 feet above and 50 feet below the station, and the current is medium. The right bank is about 3 feet high above and for a short distance below the gage, after which it rises to a height of about 10 feet. The left bank is lower than the right, and consists of a low level bar gradually sloping out from the stream and covered with willows. Neither bank overflows except at very high stages. The bed of the stream is composed of gravel and small cobblestones, free from vegetation and permanent. There is but one channel at all stages. Bench mark No. 1 is a nail driven into the top of the east end of the bottom log of the north abutment. It elevation is 1.765 feet above the zero of the gage. Bench mark No. 2 is a point on the foundation stone under the northeast corner of the house of Charles Bergquist, marked "B. M. U. S. G. S." Its elevation is 12.425 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of North Platte River (North Fork) at Higho, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 14 [a] | W. A. Lamb | 29 | 24 | 1.70 | 1.37 | 41 |
| May 27 | do | 29 | 66 | 3.47 | 2.22 | 229 |
| June 4 | do | 29 | 51 | 2.65 | 1.92 | 135 |
| June 16 | do | 29 | 60 | 3.58 | 2.10 | 215 |
| June 28 | do | 29 | 51 | 2.94 | 1.94 | 150 |
| July 13 | do | 35 | 51 | 2.02 | 1.80 | 103 |
| August 9 | do | 25 | 37 | 2.11 | 1.70 | 78 |
| September 13 [a] | do | 31 | 32 | 1.25 | 1.40 | 40 |

[a] Wading at different section.

*Mean daily gage height, in feet, of North Platte River (North Fork) at Higho, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | | 1.95 | 1.75 | 1.82 | 1.65 | 1.60 |
| 2 | | 1.92 | 1.80 | 1.75 | 1.62 | 1.50 |
| 3 | | 2.10 | 1.85 | 1.72 | 1.55 | 1.45 |
| 4 | | 1.88 | 1.88 | 1.72 | 1.52 | 1.40 |
| 5 | | 1.84 | 1.85 | 1.68 | 1.50 | 1.40 |
| 6 | | 1.55 | 1.80 | 1.68 | 1.48 | 1.40 |
| 7 | | 1.62 | 1.90 | 1.68 | 1.45 | 1.45 |
| 8 | | 1.95 | 1.92 | 1.68 | 1.45 | 1.40 |
| 9 | | 2.10 | 1.88 | 1.68 | 1.45 | 1.45 |
| 10 | | 1.95 | 1.88 | 1.62 | 1.45 | 1.48 |
| 11 | | 2.00 | 1.78 | 1.62 | 1.45 | 1.50 |
| 12 | | 2.08 | 1.82 | 1.65 | 1.40 | 1.48 |
| 13 | | 2.12 | 1.82 | 1.70 | 1.40 | 1.45 |
| 14 | 1.35 | 2.18 | 1.75 | 1.68 | 1.40 | 1.50 |
| 15 | 1.40 | 2.05 | 1.72 | 1.68 | 1.35 | 1.50 |
| 16 | 1.42 | 2.05 | 1.78 | 1.70 | 1.35 | 1.46 |
| 17 | 1.45 | 2.10 | 1.65 | 1.78 | 1.30 | 1.45 |
| 18 | 1.48 | 2.02 | 1.68 | 1.85 | 1.30 | 1.45 |
| 19 | 1.60 | 2.15 | 1.72 | 1.80 | 1.32 | 1.45 |
| 20 | 1.75 | 2.10 | 1.78 | 1.70 | 1.37 | 1.50 |
| 21 | 1.85 | 2.10 | 1.82 | 1.72 | 1.36 | 1.47 |
| 22 | 1.85 | 2.10 | 1.78 | 1.68 | 1.38 | 1.40 |
| 23 | 1.95 | 2.05 | 1.80 | 1.60 | 1.50 | 1.38 |
| 24 | 2.10 | 2.08 | 1.80 | 1.60 | 1.40 | 1.40 |
| 25 | 2.10 | 2.05 | 1.88 | 1.60 | 1.40 | 1.40 |
| 26 | 2.15 | 2.02 | 1.88 | 1.60 | 1.40 | 1.35 |
| 27 | 2.25 | 2.02 | 1.80 | 1.60 | 1.40 | 1.25 |
| 28 | 2.08 | 1.90 | 1.80 | 1.60 | 1.40 | 1.18 |
| 29 | 1.88 | 1.85 | 1.82 | 1.60 | 1.45 | 1.15 |
| 30 | 1.98 | 1.75 | 1.88 | 1.60 | 1.80 | 1.18 |
| 31 | 2.00 | | 1.85 | 1.58 | | 1.20 |

*Rating table for North Platte River (North Fork) at Higho, Colo., from May 14 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.15 | 27 | 1.45 | 46 | 1.75 | 90 | 2.00 | 160 |
| 1.20 | 29 | 1.50 | 50 | 1.80 | 100 | 2.10 | 195 |
| 1.25 | 31 | 1.55 | 57 | 1.85 | 115 | 2.20 | 235 |
| 1.30 | 34 | 1.60 | 64 | 1.90 | 130 | 2.30 | 280 |
| 1.35 | 38 | 1.65 | 72 | 1.95 | 145 | 2.40 | 330 |
| 1.40 | 42 | 1.70 | 80 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 1.35 feet and 2.2 feet.

*Estimated monthly discharge of North Platte River (North Fork) at Higho, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 14–31 | 257 | 38 | 124 | 4,427 |
| June | 227 | 57 | 159 | 9,461 |
| July | 136 | 72 | 105 | 6,456 |
| August | 115 | 61 | 77.5 | 4,765 |
| September | 100 | 34 | 46.9 | 2,791 |
| October | 64 | 27 | 43.3 | 2,662 |
| The period | | | | 30,560 |

## NORTH PLATTE RIVER NEAR COWDREY, COLO.

This station was established May 10, 1904, by M. C. Hinderlider. It is located at the wagon bridge about 2 miles northwest of Cowdrey, Colo. A plain, vertical, staff gage, graduated to feet and tenths, is spiked to the northeast corner of the first crib pier from the west end of the bridge. The foot marks are numbered from 2 to 12 feet, the 2-foot mark resting on the bed of the stream. The gage is read twice each day by A. H. Hendrickson. Discharge measurements are made by means of a five-eighths inch steel cable, car, and tagged wire, located one-fourth mile below the bridge to which the gage is attached. Sounding points are marked every 5 feet on the tagged wire. The initial point for soundings is the zero of the tagged wire, near the left bank. The channel is straight for about 600 feet above and 900 feet below the station, and the current is medium at all stages. The river

at the station has a fall of 4.22 feet to the mile, but along its entire course the fall is much greater. Both banks are high, clean, and do not overflow. The bed of the stream is composed of coarse gravel and small cobblestones, and is firm, stable, and uniform. Bench mark No. 1 is the top of a 30-penny nail driven flush with the top of the cap timber on the north end of the right abutment of the bridge. Its elevation is 13.219 feet above gage datum. Bench mark No. 2 is an iron wagon skein set in the right bank at the right end of the bridge. The top of the hub is 2 inches above the surface of the ground, the base resting on a stone 1 foot below the surface. A witness stake is set beside the bench-mark post. The elevation of bench mark No. 2 is 10.890 feet above gage datum. Bench mark No. 3 is on the hillside, on the right side of river, 55 feet southeast of east end of foot bridge. It is an iron rod 30 x 1¼ inches and has a V-shaped bend on the lower end which rests on a solid boulder 2½ feet underground. The elevation is 400.00 feet above the gage zero.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of North Platte River near Cowdrey, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 9 | W. A. Lamb | 150 | 324 | 1.09 | 7.95 | 354 |
| May 17 [a] | do | 110 | 282 | 1.71 | 8.08 | 482 |
| May 23 | do | 117 | 395 | 2.92 | 8.90 | 1,155 |
| May 30 | do | 116 | 398 | 2.77 | 8.95 | 1,101 |
| June 7 | do | 110 | 310 | 1.85 | 8.24 | 574 |
| June 17 | do | 110 | 416 | 3.23 | 9.05 | 1,345 |
| June 29 | do | 108 | 312 | 1.78 | 8.20 | 556 |
| July 7 | do | 107 | 285 | 1.70 | 8.10 | 484 |
| August 3 | do | 97 | 204 | 0.86 | 7.60 | 176 |
| August 22 | do | 100 | 208 | 0.82 | 7.66 | 171 |
| September 6 | do | 92 | 176 | 0.53 | 7.48 | 94 |
| September 24 | do | 90 | 164 | 0.49 | 7.42 | 80 |

[a] Cable station established.

*Mean daily gage height, in feet, of North Platte River near Cowdrey, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 8.90 | 8.22 | 7.70 | 7.55 | 7.48 |
| 2 | ..... | 8.72 | 8.25 | 7.65 | 7.58 | 7.50 |
| 3 | ..... | 8.90 | 8.22 | 7.62 | 7.55 | 7.50 |
| 4 | ..... | 8.95 | 8.10 | 7.62 | 7.55 | 7.40 |
| 5 | ..... | 8.60 | 8.08 | 7.58 | 7.50 | 7.40 |
| 6 | ..... | 8.35 | 8.02 | 7.60 | 7.50 | 7.55 |
| 7 | ..... | 8.20 | 8.30 | 7.58 | 7.55 | 7.70 |
| 8 | ..... | 8.40 | 8.00 | 7.55 | 7.52 | 7.55 |
| 9 | ..... | 8.75 | 8.00 | 7.52 | 7.45 | 7.70 |
| 10 | ..... | 8.80 | 7.90 | 7.50 | 7.45 | 7.60 |
| 11 | ..... | 8.78 | 7.90 | 7.55 | 7.42 | 7.50 |
| 12 | 7.90 | 8.95 | 7.88 | 7.62 | 7.30 | 7.40 |
| 13 | 8.00 | 9.05 | 7.80 | 7.65 | 7.35 | 7.40 |
| 14 | 8.00 | 9.10 | 7.72 | 7.55 | 7.40 | 7.40 |
| 15 | 8.05 | 9.05 | 7.70 | 7.55 | 7.38 | 7.40 |
| 16 | 8.10 | 9.00 | 7.70 | 7.55 | 7.35 | 7.40 |
| 17 | 8.10 | 8.90 | 7.65 | 7.62 | 7.40 | 7.40 |
| 18 | 8.02 | 8.90 | 7.60 | 7.70 | 7.40 | 7.40 |
| 19 | 8.18 | 8.92 | 7.68 | 7.75 | 7.35 | 7.40 |
| 20 | 8.38 | 8.82 | 7.68 | 7.70 | 7.35 | 7.40 |
| 21 | 8.60 | 8.82 | 7.70 | 7.65 | 7.35 | 7.40 |
| 22 | 8.70 | 8.75 | 7.68 | 7.65 | 7.35 | 7.40 |
| 23 | 8.75 | 8.80 | 7.70 | 7.65 | 7.40 | 7.40 |
| 24 | 9.05 | 8.72 | 7.65 | 7.62 | 7.40 | 7.40 |
| 25 | 9.22 | 8.65 | 7.75 | 7.52 | 7.40 | 7.40 |
| 26 | 9.30 | 8.50 | 7.72 | 7.55 | 7.40 | 7.40 |
| 27 | 9.25 | 8.40 | 7.70 | 7.55 | 7.40 | 7.40 |
| 28 | 8.95 | 8.30 | 7.70 | 7.50 | 7.40 | 7.40 |
| 29 | 8.80 | 8.22 | 7.75 | 7.55 | 7.40 | 7.40 |
| 30 | 8.85 | 8.22 | 7.75 | 7.55 | 7.40 | 7.40 |
| 31 | 8.95 | ..... | 7.70 | 7.55 | ..... | 7.30 |

*Rating table for North Platte River near Cowdrey, Colo., from May 12 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 7.30 | 40 | 7.70 | 208 | 8.20 | 540 | 8.90 | 1,172 |
| 7.35 | 55 | 7.75 | 238 | 8.30 | 622 | 9.00 | 1,282 |
| 7.40 | 70 | 7.80 | 270 | 8.40 | 707 | 9.10 | 1,400 |
| 7.45 | 88 | 7.85 | 302 | 8.50 | 793 | 9.20 | 1,523 |
| 7.50 | 108 | 7.90 | 334 | 8.60 | 880 | 9.30 | 1,650 |
| 7.55 | 130 | 7.95 | 366 | 8.70 | 794 | 9.40 | 1,781 |
| 7.60 | 154 | 8.00 | 398 | 8.80 | 1,070 | 9.50 | 1,916 |
| 7.65 | 180 | 8.10 | 466 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1904. It is well defined to gage height 9 feet. The table has been extended above gage height 9 feet.

*Estimated monthly discharge of North Platte River near Cowdrey, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 12–31 | 1,650 | 334 | 888 | 35,230 |
| June | 1,400 | 540 | 1,002 | 59,620 |
| July | 622 | 154 | 304 | 18,690 |
| August | 238 | 108 | 154 | 9,469 |
| September | 144 | 40 | 81.8 | 4,867 |
| October | 208 | 40 | 89.2 | 5,485 |
| The period | | | | 133,400 |

## NORTH PLATTE RIVER NEAR PINKHAMPTON, COLO.

This station was established May 11, 1904, by M. C. Hinderlider. It is located at the footbridge on Hunter's ranch, 3 miles northwest of Pinkhampton, Colo. A plain, vertical staff gage, graduated to feet and tenths, is fastened to cantilever arms which extend out over the water on the left bank of the stream, just above the footbridge. The 3-foot mark of the gage rests on the bed of the stream. The gage is read twice each day by Mrs. Glennie Hunter. Discharge measurements are made from the suspension footbridge near which the gage is placed. The bridge is marked every 5 feet up to 160 feet. The initial point for soundings is the top of the left bank beneath the bridge, marked zero with a tin tag fastened to the bridge. The channel is straight for about 600 feet above and one-fourth mile below the station, and the current is medium and uniform. The right bank is low, lined with bushes, and is not liable to overflow. The left bank is about 5 feet high, lined with willows, and seldom overflows. The bed of the stream is composed of cobblestones, some silt, and a few small bowlders. It is uniform, free from vegetation, and permanent. Bench mark No. 1 is a 30-penny nail driven into the west root of a 24-inch cottonwood tree standing on the brow of the hill, about 75 feet east of the east end of the bridge. Its elevation is 16.492 feet above the gage datum. Bench mark No. 2 is a nail driven into the top of post on the left bank, to which the gage is fastened. Its elevation is 11.262 feet above gage datum. Bench mark No. 3 is the top of a wrought-iron rod, 30 inches long and 1¼ inches in diameter, the lower end of which rests upon a large bowlder 2.5 feet underground, 55 feet southeast of the right end of the bridge. Its elevation is 14.00 feet above gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of North Platte River near Pinkhampton, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 11 | W. A. Lamb | 125 | 326 | 1.29 | 4.92 | 420 |
| May 23 | do | 138 | 480 | 2.66 | 5.98 | 1,275 |
| May 31 | do | 138 | 535 | 3.04 | 6.25 | 1,624 |
| June 6 | do | 137 | 479 | 2.47 | 5.91 | 1,184 |
| August 4 | do | 108 | 277 | .88 | 4.55 | 244 |
| September 5 | do | 101 | 247 | .75 | 4.40 | 187 |
| September 25 | do | 99 | 214 | .56 | 4.19 | 121 |

*Mean daily gage height, in feet, of North Platte River near Pinkhampton, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|
| 1 | ..... | 6.30 | 5.50 | 4.70 | 4.45 | 4.30 | 4.18 |
| 2 | ..... | 6.10 | 5.70 | 4.62 | 4.55 | 4.30 | 4.10 |
| 3 | ..... | 6.30 | ..... | 4.55 | 4.60 | 4.20 | 4.10 |
| 4 | ..... | 6.70 | ..... | 4.50 | ..... | 4.20 | 4.10 |
| 5 | ..... | 6.40 | 5.45 | 4.50 | ..... | 4.20 | 4.10 |
| 6 | ..... | 5.95 | 5.40 | 4.50 | ..... | 4.10 | 4.10 |
| 7 | ..... | 5.75 | 5.50 | 4.50 | ..... | 4.10 | 4.10 |
| 8 | ..... | 5.70 | 5.40 | 4.40 | ..... | 4.10 | 4.10 |
| 9 | ..... | 6.20 | 5.35 | 4.40 | ..... | 4.10 | 4.10 |
| 10 | ..... | 6.20 | 5.20 | 4.40 | ..... | 4.15 | ..... |
| 11 | 4.90 | 6.25 | 5.10 | 4.40 | 4.25 | 4.20 | ..... |
| 12 | 4.95 | 6.45 | 5.06 | 4.50 | 4.25 | 4.20 | ..... |
| 13 | 5.00 | 6.50 | 5.00 | 4.45 | 4.20 | 4.20 | ..... |
| 14 | 5.05 | 6.50 | 4.92 | 4.40 | 4.20 | 4.20 | ..... |
| 15 | 5.10 | 6.60 | 4.85 | 4.40 | 4.15 | 4.20 | ..... |
| 16 | 5.15 | 6.50 | 4.80 | 4.50 | 4.10 | 4.20 | ..... |
| 17 | 5.20 | 6.45 | 4.75 | 4.65 | 4.10 | 4.20 | ..... |
| 18 | 5.15 | 6.40 | 4.70 | 4.80 | 4.10 | 4.20 | ..... |
| 19 | 5.25 | ..... | 4.70 | 4.80 | 4.10 | 4.30 | ..... |
| 20 | 5.35 | 6.25 | 4.70 | 4.70 | 4.10 | 4.30 | ..... |
| 21 | 5.60 | 6.20 | 4.75 | 4.60 | 4.10 | 4.30 | ..... |
| 22 | 5.80 | 6.15 | 4.70 | 4.65 | 4.10 | 4.30 | ..... |
| 23 | 5.95 | 6.22 | 4.70 | 4.58 | 4.10 | 4.30 | ..... |
| 24 | 6.10 | 6.10 | 4.80 | 4.45 | 4.20 | 4.30 | ..... |
| 25 | 6.50 | 6.10 | 4.75 | 4.40 | 4.15 | 4.30 | ..... |
| 26 | 6.75 | 5.95 | 4.70 | 4.42 | 4.10 | 4.30 | ..... |
| 27 | 6.80 | 5.75 | 4.70 | 4.42 | 4.20 | 4.30 | ..... |
| 28 | 6.60 | 5.65 | 4.70 | 4.40 | 4.20 | 4.25 | ..... |
| 29 | 6.50 | 5.55 | 4.72 | 4.40 | 4.20 | 4.20 | ..... |
| 30 | 6.10 | 5.45 | 4.80 | 4.40 | 4.25 | 4.25 | ..... |
| 31 | 6.15 | ..... | 4.80 | 4.45 | ..... | 4.20 | ..... |

*Rating table for North Platte River near Pinkhamptor Colo., from May 11 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage neight. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.10 | 100 | 4.50 | 224 | 5.30 | 666 | 6.10 | 1,416 |
| 4.15 | 112 | 4.60 | 265 | 5.40 | 741 | 6.20 | 1,543 |
| 4.20 | 125 | 4.70 | 310 | 5.50 | 821 | 6.30 | 1,684 |
| 4.25 | 139 | 4.80 | 359 | 5.60 | 906 | 6.40 | 1,837 |
| 4.30 | 154 | 4.90 | 412 | 5.70 | 995 | 6.50 | 2,000 |
| 4.35 | 170 | 5.00 | 469 | 5.80 | 1,090 | 6.60 | 2,170 |
| 4.40 | 187 | 5.10 | 530 | 5.90 | 1,192 | 6.70 | 2,350 |
| 4.45 | 205 | 5.20 | 595 | 6.00 | 1,300 | 6.80 | 2,540 |

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined to gage height 6.25 feet. The table has been extended above gage height 6.25 feet.

*Estimated monthly discharge of North Platte River near Pinkhampton, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 11–31 | 2,540 | 412 | 1,148 | 47,820 |
| June | 2,350 | 780 | 1,547 | 92,050 |
| July | 995 | 310 | 499 | 30,680 |
| August | 359 | 187 | 231 | 14,200 |
| September | 265 | 100 | 144 | 8,569 |
| October | 154 | 100 | 133 | 8,178 |
| November 1–9 | 120 | 100 | 102 | 1,821 |
| The period | | | | 203,300 |

## NORTH PLATTE RIVER AT SARATOGA, WYO.

This station was established June 9, 1903, by A. J. Parshall. The gage consists of a flexible Gurley rod fastened securely to a 3 by 6 inch timber, spiked and braced to the crib work at the northeast corner of Harry Kuykendal's residence, 100 yards below the bridge, on the left bank of the river. The gage is read twice each day by J. M. Sterrett. Discharge measurements are made from the county bridge, a two-span steel structure connecting East and West Saratoga. The initial point for soundings is on the east end of the bridge, at the pier. The channel is straight for 500 feet above and 400 feet below the station. The current has a measurable velocity at all stages. The

left bank is high, but overflows at a gage height of 7 feet. The right bank overflows only at extreme high water. The river has a permanent bed of cobblestone and gravel. There is but one channel, broken by the center pier of the bridge. Bench mark No. 1 is a cross on the south side of the southwest pier at the bottom of the top section. Its elevation is 10.70 feet above the zero of the gage. Bench mark No. 2 is a spike driven in a cottonwood tree standing about 30 feet northwest of the gage. Its elevation is 9.84 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

*Discharge measurements of North Platte River at Saratoga, Wyo., in 1904.*

| Date. | Hydrogapher. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 15 | A. J. Parshall | 215 | 574 | 1.06 | 2.05 | 607 |
| April 9 | do | 215 | 521 | 1.12 | 2.05 | 587 |
| April 12 | J. M. Sterrett | 225 | 670 | 2.02 | 2.65 | 1,351 |
| April 15 | do | 234 | 773 | 2.76 | 3.10 | 2,132 |
| May 11 | do | 240 | 891 | 3.22 | 3.60 | 2,872 |
| May 18 | do | 246 | 986 | 4.17 | 4.10 | 4,116 |
| May 20 | do | 249 | 1,113 | 5.14 | 4.55 | 5,718 |
| May 23 | do | 250 | 1,237 | 5.86 | 5.10 | 7,251 |
| May 26 | do | 250 | 1,364 | 6.27 | 5.60 | 8,551 |
| August 10 | A. J. Parshall | 208 | 474 | .76 | 1.80 | 359 |
| August 25 | do | 210 | 475 | .87 | 1.90 | 412 |
| September 20[a] | do | 130 | 129 | 1.84 | 1.53 | 238 |

[a] Wading one-fourth mile below station.

*Mean daily gage height, in feet, of North Platte River at Saratoga, Wyo., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.72 | ..... | 2.01 | 1.98 | 3.25 | 4.82 | 3.45 | 2.18 | 2.10 | 1.98 | 1.72 | 1.48 |
| 2 | 1.74 | ..... | 1.98 | 1.95 | 3.30 | 4.80 | 3.48 | 2.08 | 2.08 | 1.88 | 1.62 | 1.62 |
| 3 | 1.78 | ..... | 1.94 | 2.12 | 3.32 | 4.75 | 3.48 | 2.02 | 2.05 | 1.80 | 1.65 | 1.45 |
| 4 | 1.82 | ..... | 1.98 | 2.12 | 3.35 | 4.75 | 3.42 | 1.95 | 2.02 | 1.78 | 1.68 | 1.32 |
| 5 | 1.78 | ..... | 1.92 | 2.25 | 3.28 | 4.52 | 3.32 | 1.95 | 1.95 | 1.72 | 1.60 | 1.35 |
| 6 | 1.74 | ..... | 1.98 | 2.35 | 3.28 | 4.30 | 3.20 | 1.90 | 1.88 | 1.70 | 1.65 | 1.42 |
| 7 | 1.70 | ..... | 2.00 | 2.28 | 3.42 | 4.18 | 3.30 | 1.88 | 1.82 | 1.70 | 1.60 | 1.38 |
| 8 | 1.65 | ..... | 2.28 | 2.18 | 3.32 | 4.40 | 3.10 | 1.82 | 1.78 | 1.70 | 1.55 | 1.50 |
| 9 | 1.60 | ..... | 2.32 | 2.10 | 3.38 | 4.72 | 3.08 | 1.80 | 1.72 | 1.72 | 1.58 | 1.62 |
| 10 | 1.83 | ..... | 2.10 | 2.12 | 3.40 | 4.65 | 2.98 | 1.80 | 1.70 | 1.82 | 1.45 | 1.50 |
| 11 | 1.67 | ..... | 2.30 | 2.32 | 3.50 | 4.78 | 2.88 | 1.82 | 1.70 | 1.82 | 1.40 | ..... |
| 12 | 1.74 | ..... | 2.35 | 2.60 | 3.62 | 4.88 | 2.78 | 1.95 | 1.65 | 1.85 | 1.40 | ..... |
| 13 | 1.80 | ..... | 2.12 | 2.82 | 3.58 | 4.98 | 2.70 | 2.00 | 1.65 | 1.88 | 1.52 | ..... |
| 14 | 1.76 | ..... | 2.15 | 2.98 | 3.68 | 5.00 | 2.65 | 2.02 | 1.60 | 1.92 | 1.65 | ..... |
| 15 | 1.74 | ..... | 2.08 | 3.15 | 3.75 | 4.92 | 2.55 | 2.00 | 1.60 | 1.90 | 1.62 | ..... |
| 16 | 1.71 | ..... | 2.00 | 3.18 | 3.90 | 4.88 | 2.45 | 2.00 | 1.60 | 1.88 | 1.68 | ..... |
| 17 | 1.65 | ..... | 2.02 | 3.10 | 3.88 | 4.80 | 2.42 | 2.00 | 1.58 | 1.88 | 1.70 | ..... |
| 18 | 1.67 | ..... | 2.15 | 3.15 | 4.02 | 4.65 | 2.38 | 2.32 | 1.55 | 1.90 | 1.70 | ..... |
| 19 | 1.70 | ..... | 2.20 | 3.25 | 4.18 | 4.58 | 2.32 | 2.28 | 1.52 | 1.88 | 1.72 | ..... |
| 20 | 1.65 | ..... | 2.30 | 3.32 | 4.50 | 4.52 | 2.28 | 2.18 | 1.52 | 1.85 | 1.50 | ..... |
| 21 | 1.73 | ..... | 2.12 | 3.45 | 4.72 | 4.42 | 2.30 | 2.08 | 1.60 | 1.88 | 1.65 | ..... |
| 22 | 1.76 | ..... | 2.22 | 3.32 | 4.78 | 4.40 | 2.30 | 2.02 | 1.60 | 1.85 | 1.58 | ..... |
| 23 | 1.80 | ..... | 2.22 | 3.15 | 5.00 | 4.32 | 2.22 | 2.00 | 1.60 | 1.88 | 1.60 | ..... |
| 24 | 1.76 | ..... | 2.20 | 3.00 | 5.18 | 4.28 | 2.22 | 2.00 | 1.68 | 1.85 | 1.50 | ..... |
| 25 | 1.80 | ..... | 2.08 | 2.90 | 5.42 | 4.10 | 2.35 | 1.98 | 1.70 | 1.82 | 1.60 | ..... |
| 26 | 1.83 | ..... | 2.00 | 2.88 | 5.48 | 3.95 | 2.32 | 1.90 | 1.70 | 1.78 | 1.45 | ..... |
| 27 | 1.84 | ..... | 2.00 | 2.98 | 5.20 | 3.82 | 2.22 | 1.92 | 1.70 | 1.78 | 1.58 | ..... |
| 28 | 1.82 | ..... | 2.00 | 3.15 | 5.05 | 3.68 | 2.12 | 1.95 | 1.65 | 1.75 | 1.65 | ..... |
| 29 | 1.85 | (a) | 1.98 | 3.35 | 4.90 | 3.60 | 2.18 | 1.95 | 1.70 | 1.75 | 1.50 | ..... |
| 30 | 1.88 | ..... | 2.00 | 3.28 | 4.88 | 3.50 | 2.20 | 1.95 | 1.82 | 1.78 | 1.58 | ..... |
| 31 | 1.90 | ..... | 1.95 | ..... | 4.95 | ..... | 2.20 | 2.00 | ..... | 1.75 | ..... | ..... |

[a] River free from ice.

*Rating table for North Platte River at Saratoga, Wyo., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 165 | 2.30 | 780 | 3.40 | 2,500 | 4.50 | 5,445 |
| 1.35 | 180 | 2.40 | 890 | 3.50 | 2,710 | 4.60 | 5,760 |
| 1.40 | 195 | 2.50 | 1,010 | 3.60 | 2,935 | 4.70 | 6,080 |
| 1.45 | 210 | 2.60 | 1,140 | 3.70 | 3,170 | 4.80 | 6,400 |
| 1.50 | 225 | 2.70 | 1,280 | 3.80 | 3,415 | 4.90 | 6,720 |
| 1.60 | 260 | 2.80 | 1,430 | 3.90 | 3,670 | 5.00 | 7,040 |
| 1.70 | 305 | 2.90 | 1,590 | 4.00 | 3,935 | 5.10 | 7,360 |
| 1.80 | 360 | 3.00 | 1,760 | 4.10 | 4,220 | 5.20 | 7,680 |
| 1.90 | 425 | 3.10 | 1,940 | 4.20 | 4,520 | 5.30 | 8,010 |
| 2.00 | 500 | 3.20 | 2,120 | 4.30 | 4,825 | 5.40 | 8,340 |
| 2.10 | 585 | 3.30 | 2,305 | 4.40 | 5,135 | 5.50 | 8,670 |
| 2.20 | 680 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904, and is fairly well defined.

*Estimated monthly discharge of North Platte River at Saratoga, Wyo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January [a] | 425 | 260 | 336 | 20,660 |
| March | 835 | 439 | 588 | 36,160 |
| April | 2,600 | 460 | 1,480 | 88,070 |
| May | 8,604 | 2,210 | 4,487 | 295,900 |
| June | 7,040 | 2,710 | 5,385 | 320,400 |
| July | 2,666 | 603 | 1,340 | 82,390 |
| August | 802 | 360 | 499 | 30,680 |
| September | 585 | 231 | 332 | 19,760 |
| October | 484 | 305 | 375 | 23,060 |
| November | 315 | 195 | 259 | 15,410 |
| December 1–10 | 268 | 171 | 216 | 4,284 |
| The period | | | | 936,800 |

[a] Ice conditions uncertain during January.

## NORTH PLATTE RIVER AT ALCOVA, WYO.

This station was established February 19, 1904, by John E. Field. It is located at the highway bridge 1,000 feet southwest of the post-office at Alcova, Wyo. There are no running tributaries entering the river in this vicinity. The gage is a 2 by 6 inch plank nailed to the northeast corner of the crib pier supporting the center of the bridge. The gage is read twice a day by A. F. Hollebaugh, the postmaster. Measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the north end of the downstream hand rail. The channel is straight for 1,500 feet above and 800 feet below the station. The current is swift in the center and sluggish near the banks. Both banks are high, clean, and not liable to overflow. The bed of the stream is rocky, covered with small bowlders, and is permanent. The river is divided by the bridge piers into ten channels at low water and thirteen channels at high water. The bottom at the measuring section is rough and uneven, and this may affect the accuracy somewhat. The bench mark is a standard United States Geological Survey iron post located at the west quarter corner of sec. 19, T. 30 N., R. 82 W. It is about 1,000 feet due north of the post-office. Its elevation is 5,366 feet above sea level and 36.67 feet above the gage datum.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

*Discharge measurements of North Platte River at Alcova, Wyo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 1 | J. E. Field | 270 | 1,116 | 2.96 | 7.20 | 3,308 |
| June 5 | do | 278 | 1,487 | 5.25 | 9.50 | 7,802 |
| June 10 | E. C. Woodward | 279 | 1,401 | 4.78 | 9.00 | 6,696 |
| June 20 | do | 283 | 1,471 | 5.51 | 9.45 | 8,112 |
| June 20 | J. E. Field | 280 | 1,435 | 5.26 | 9.10 | 7,546 |
| July 17 | do | 210 | 642 | 2.02 | 5.55 | 1,300 |

*Mean daily gage height, in feet, of North Platte River at Alcova, Wyo., for 1904.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 4.98 | 4.95 | 7.20 | 9.60 | 7.30 | 4.80 | 4.50 | 4.18 | 4.40 |
| 2 | ..... | 5.30 | 4.98 | 7.12 | 9.55 | 7.30 | 4.80 | 4.50 | 4.20 | 4.40 |
| 3 | ..... | 5.18 | 4.88 | 7.15 | 9.50 | 7.30 | 4.80 | 4.55 | 4.25 | 4.40 |
| 4 | ..... | 4.95 | 4.88 | 7.25 | 9.45 | 7.20 | 4.75 | 4.70 | 4.45 | 4.38 |
| 5 | ..... | 4.95 | 4.90 | 7.25 | 9.45 | 7.32 | 4.70 | 4.62 | 4.40 | 4.32 |
| 6 | ..... | 4.90 | 4.92 | 7.30 | 9.20 | 7.30 | 4.65 | 5.58 | 4.35 | 4.28 |
| 7 | ..... | 5.02 | 5.10 | 7.38 | 8.80 | 6.95 | 4.58 | 4.50 | 4.20 | 4.25 |
| 8 | ..... | 5.00 | 5.30 | 7.39 | 8.55 | 6.85 | 4.50 | 4.48 | 4.30 | 4.25 |
| 9 | ..... | 4.90 | 5.45 | 7.52 | 8.55 | 6.78 | 4.50 | 4.38 | 4.20 | 4.20 |
| 10 | ..... | 5.00 | 5.30 | 7.55 | 9.20 | 6.65 | 4.42 | 4.30 | 4.20 | 4.20 |
| 11 | ..... | 5.38 | 5.20 | 7.38 | 9.25 | 6.40 | 4.40 | 4.22 | 4.20 | 4.05 |
| 12 | ..... | 5.52 | 5.05 | 7.40 | 9.50 | 6.25 | 4.40 | 4.20 | 4.20 | 3.85 |
| 13 | ..... | 5.22 | 5.08 | 7.65 | 9.50 | 6.10 | 4.40 | 4.18 | 4.45 | 3.65 |
| 14 | ..... | 5.32 | 5.65 | 7.75 | 9.65 | 5.95 | 4.35 | 4.10 | 4.50 | 3.45 |
| 15 | ..... | 5.45 | 6.05 | 7.90 | 9.70 | 5.80 | 4.38 | 4.10 | 4.50 | 3.40 |
| 16 | ..... | 5.28 | 6.35 | 7.80 | 9.65 | 5.72 | 4.58 | 4.02 | 4.50 | 3.45 |
| 17 | ..... | 5.18 | 6.48 | 8.05 | 9.55 | 5.60 | 4.62 | 4.00 | 4.50 | 3.55 |
| 18 | ..... | 5.15 | 6.45 | 8.15 | 9.40 | 5.45 | 4.70 | 4.00 | 4.50 | 3.75 |
| 19 | ..... | 5.05 | 6.40 | 8.52 | 9.20 | 5.35 | 4.70 | 3.92 | 4.50 | 3.90 |
| 20 | ..... | 5.02 | 6.52 | 9.18 | 9.10 | 5.30 | 4.78 | 3.85 | 4.50 | ..... |
| 21 | 4.20 | 5.05 | 6.68 | 9.15 | 9.05 | 5.18 | 4.98 | 3.80 | 4.50 | ..... |
| 22 | 4.25 | 5.15 | 6.92 | 9.50 | 8.85 | 5.05 | 4.88 | 3.88 | 4.50 | ..... |
| 23 | 4.25 | 5.15 | 6.95 | 9.60 | 8.75 | 5.00 | 4.75 | 3.88 | 4.50 | ..... |
| 24 | 4.40 | 5.20 | 6.90 | 9.88 | 8.60 | 5.00 | 4.62 | 3.90 | 4.72 | ..... |
| 25 | 4.55 | 5.02 | 6.75 | 10.35 | 8.45 | 4.95 | 4.58 | 3.90 | 4.72 | ..... |
| 26 | 4.65 | 4.88 | 6.55 | 10.60 | 8.30 | 5.00 | 4.50 | 3.92 | 4.50 | ..... |
| 27 | 4.95 | 4.65 | 6.35 | 10.85 | 8.05 | 4.90 | 4.50 | 3.90 | 4.50 | ..... |
| 28 | 5.30 | 4.70 | 6.35 | 10.50 | 7.80 | 4.90 | 4.58 | 3.95 | 4.50 | ..... |
| 29 | 5.10 | 5.08 | 6.48 | 10.20 | 7.45 | 5.00 | 4.65 | 4.05 | 4.50 | ..... |
| 30 | ..... | 5.12 | 6.92 | 9.80 | 7.30 | 4.90 | 4.45 | 4.08 | 4.68 | ..... |
| 31 | ..... | 4.95 | ..... | 9.45 | ..... | 4.80 | 4.45 | ..... | 4.40 | ..... |

## NORTH PLATTE RIVER NEAR GUERNSEY, WYO.

This station was established June 14, 1900, by A. J. Parshall. It is located at the county bridge about a half mile northwest of Guernsey. The bridge has eight piers, the sides are planked, and there is uniform flow under each span. The rod originally consisted of a 4 by 4 inch scantling 12 feet long firmly attached to one of the piers of the bridge. As the station was to be a temporary one, a metallic tape, divided into feet and tenths, was securely fastened to the rod.

It was found that considerable inconvenience was caused by sand accumulating about the rod as the high water subsided. With the opening of the season of 1902 a new rod was placed about 200 feet above the first location. It was fastened to one of the piers of the railroad bridge, and was placed 1 foot lower in the water.

The 1902 bench mark is a spike driven into a cross beam of the bridge 1 foot from the rod and at an elevation of 10.04 feet above the zero. The channel is straight for a distance above and below the station.

Both banks are high and do not overflow at high stages. The bed of the stream is sandy, but probably does not shift much.

During the latter part of the season of 1903 the 1902 gage was replaced by a new rod, with its zero at the same elevation as that of the old gage. The new rod is attached to a pile of the railroad bridge, which has been recently reconstructed. In February, 1904, the elevation of the new rod was checked with the temporary bench mark and by comparison with the readings of the old rods which are still in place. This comparison shows that the rod has settled 0.076 foot. The 1903 bench mark is a monument set 125 feet southeast of the rod at an elevation of 13.65 feet above the zero of the gage and 4,331 feet above sea level.

Measurements are still made from the county bridge, which, though it does not furnish a perfect location for measurements, is the best yet found on the river in Wyoming below the Saratoga station.

The observations at this station during 1904 have been made under the direction of A. J. Parshall, resident hydrographer.

*Discharge measurements of North Platte River near Guernsey, Wyo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 18 | A. J. Parshall | 279 | 538 | 2.39 | 1.10 | 1,288 |
| April 27 | J. E. Field | | 849 | 3.24 | 2.10 | 2,750 |
| May 12 | A. J. Parshall | 331 | 1,107 | 4.40 | 2.80 | 4,871 |
| June 8 | do | 337 | 1,861 | 5.65 | 5.25 | 10,510 |
| June 15 | do | 238 | 1,835 | 5.42 | 5.00 | 9,934 |
| July 4 | do | 337 | 1,101 | 3.92 | 2.85 | 4,311 |
| July 21 | do | 216 | 498 | 3.21 | 1.35 | 1,600 |
| July 30 | do | 175 | 410 | 2.42 | .90 | 1,094 |
| August 5 | do | 172 | 358 | 2.45 | .70 | 878 |
| August 29 | do | 170 | 322 | 1.99 | .50 | 640 |
| September 5 | do | 166 | 302 | 1.86 | .45 | 564 |
| September 15 | do | 165 | 287 | 1.73 | .37 | 498 |
| September 28 [a] | do | 132 | 249 | 1.29 | .10 | 322 |
| October 24 | do | 168 | 312 | 1.88 | .48 | 586 |
| October 27 | do | 168 | 308 | 1.88 | .48 | 578 |

[a] This measurement was made by wading at a point 100 feet above county bridge.

*Mean daily gage height, in feet, of North Platte River near Guernsey, Wyo., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.90 | ..... | 0.85 | 0.80 | 1.90 | 5.05 | 3.15 | 0.80 | 0.40 | 0.18 | 0.50 | 0.22 |
| 2 | .90 | ..... | 1.00 | .80 | 1.95 | 4.90 | 3.05 | .80 | .40 | .15 | .50 | .30 |
| 3 | .90 | ..... | .95 | .85 | 2.30 | 4.80 | 2.90 | .70 | .80 | .15 | .50 | .42 |
| 4 | .90 | ..... | .90 | .90 | 3.25 | 4.80 | 2.90 | .70 | .70 | .15 | .50 | .50 |
| 5 | .90 | ..... | 1.00 | .85 | 3.15 | 5.45 | 3.00 | .70 | .55 | .15 | .50 | .50 |
| 6 | .90 | ..... | 1.65 | .80 | 3.05 | 5.65 | 3.10 | .70 | .50 | .20 | .50 | .30 |
| 7 | .90 | ..... | 1.15 | .80 | 2.95 | 5.40 | 3.00 | .70 | .48 | .22 | .50 | .30 |
| 8 | .90 | ..... | 1.05 | .80 | 2.90 | 5.10 | 3.00 | .70 | .42 | .28 | .40 | .30 |
| 9 | .90 | ..... | .85 | .85 | 2.90 | 5.40 | 2.90 | .60 | .40 | .35 | .40 | .30 |
| 10 | .80 | ..... | .80 | .90 | 3.00 | 5.40 | 2.75 | .60 | .40 | .35 | .40 | .30 |
| 11 | .80 | ..... | .90 | .95 | 2.95 | 5.00 | 2.60 | .55 | .40 | .30 | .40 | .55 |
| 12 | .80 | ..... | .90 | 1.00 | 2.80 | 5.20 | 2.45 | .50 | .40 | .30 | .40 | .70 |
| 13 | .80 | ..... | .90 | 1.00 | 2.70 | 5.20 | 2.25 | .50 | .40 | .30 | .38 | .70 |
| 14 | .80 | ..... | 1.10 | 1.00 | 2.70 | 5.15 | 2.05 | .50 | .38 | .42 | .35 | .70 |
| 15 | .90 | ..... | 1.30 | 1.00 | 2.75 | 5.05 | 1.95 | .50 | .35 | .70 | .35 | .55 |
| 16 | .90 | ..... | 1.20 | 1.00 | 2.90 | 5.10 | 1.90 | .50 | .30 | 1.70 | .30 | ..... |
| 17 | .90 | ..... | 1.20 | 1.15 | 2.90 | 5.10 | 1.80 | .50 | .30 | 1.15 | .28 | ..... |
| 18 | .80 | ..... | 1.10 | 1.55 | 2.90 | 5.00 | 1.65 | .45 | .25 | .85 | .20 | ..... |
| 19 | .90 | ..... | 1.00 | 1.75 | 2.95 | 4.90 | 1.55 | .45 | .20 | .68 | .15 | ..... |
| 20 | .90 | ..... | 1.00 | 1.95 | 3.05 | 4.80 | 1.45 | .60 | .20 | .60 | .15 | ..... |
| 21 | 1.00 | ..... | .95 | 2.00 | 3.20 | 4.70 | 1.35 | .60 | .20 | .60 | .15 | ..... |
| 22 | 1.00 | ..... | .90 | 1.95 | 5.55 | 4.55 | 1.30 | .60 | .18 | .58 | .15 | ..... |
| 23 | 1.00 | ..... | .90 | 2.00 | 4.35 | 4.45 | 1.45 | .60 | .15 | .60 | .20 | ..... |
| 24 | 1.00 | ..... | .90 | 2.05 | 4.40 | 4.35 | 1.25 | .60 | .15 | .58 | .22 | ..... |
| 25 | .90 | ..... | .95 | 2.10 | 4.55 | 4.30 | 1.15 | .60 | .10 | .55 | .28 | ..... |
| 26 | 1.00 | ..... | 1.05 | 2.10 | 4.75 | 4.15 | 1.10 | .60 | .10 | .50 | .30 | ..... |
| 27 | 1.00 | ..... | 1.00 | 2.05 | 5.05 | 3.95 | 1.00 | .55 | .10 | .50 | .38 | ..... |
| 28 | 1.00 | ..... | 1.00 | 2.00 | 5.35 | 3.80 | 1.00 | .50 | .10 | .50 | .40 | ..... |
| 29 | 1.00 | ..... | .95 | 2.00 | 5.45 | 3.65 | .95 | .48 | .10 | .50 | .38 | ..... |
| 30 | 1.00 | ..... | .90 | 1.90 | 5.25 | 3.40 | .90 | .45 | .20 | .50 | .28 | ..... |
| 31 | 1.00 | ..... | .80 | ..... | 5.20 | ..... | .80 | .45 | ..... | .50 | ..... | ..... |

NOTE.—Ice conditions uncertain during January.

*Rating table for North Platte River near Guernsey, Wyo., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.10 | 320 | 1.40 | 1,710 | 2.70 | 3,960 | 3.90 | 7,000 |
| .20 | 390 | 1.50 | 1,850 | 2.80 | 4,190 | 4.00 | 7,260 |
| .30 | 460 | 1.60 | 2,000 | 2.90 | 4,430 | 4.20 | 7,780 |
| .40 | 540 | 1.70 | 2,150 | 3.00 | 4,680 | 4.40 | 8,300 |
| .50 | 630 | 1.80 | 2,300 | 3.10 | 4,930 | 4.60 | 8,820 |
| .60 | 730 | 1.90 | 2,460 | 3.20 | 5,180 | 4.80 | 9,340 |
| .70 | 830 | 2.00 | 2,620 | 3.30 | 5,440 | 5.00 | 9,860 |
| .80 | 940 | 2.10 | 2,790 | 3.40 | 5,700 | 5.20 | 10,380 |
| .90 | 1,060 | 2.20 | 2,960 | 3.50 | 5,960 | 5.40 | 10,900 |
| 1.00 | 1,180 | 2.30 | 3,140 | 3.60 | 6,220 | 5.60 | 11,420 |
| 1.10 | 1,310 | 2.40 | 3,330 | 3.70 | 6,480 | 5.80 | 11,940 |
| 1.20 | 1,440 | 2.50 | 3,530 | 3.80 | 6,740 | 6.00 | 12,460 |
| 1.30 | 1,570 | 2.60 | 3,740 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1904. It is well defined between gage heights 0 feet and 3 feet. Above gage height 3 feet the curve is determined by two measurements at 5 feet gage height. Above gage height 3.40 feet the rating curve is a tangent, the difference being 260 per tenth.

*Estimated monthly discharge of North Platte River near Guernsey, Wyo., for 1904.*

[Drainage area, 16,240 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,180 | 940 | 1,075 | 66,100 | 0.066 | 0.076 |
| March | 2,075 | 940 | 1,191 | 73,230 | .073 | .084 |
| April | 2,790 | 940 | 1,712 | 101,900 | .105 | .117 |
| May | 11,290 | 2,460 | 6,075 | 373,500 | .374 | .431 |
| June | 11,550 | 5,700 | 9,318 | 554,500 | .574 | .640 |
| July | 5,055 | 940 | 2,802 | 172,300 | .173 | .199 |
| August | 940 | 585 | 715 | 43,960 | .044 | .051 |
| September | 940 | 320 | 488 | 29,040 | .030 | .033 |
| October | 2,150 | 355 | 652 | 40,090 | .040 | .046 |
| November | 630 | 355 | 503 | 29,930 | .031 | .035 |
| December 1-15 | 830 | 404 | 589 | 17,520 | .036 | .020 |
| The period | | | | 1,502,000 | | |

NORTH PLATTE RIVER NEAR MITCHELL, NEBR.

This station was established June 3, 1902, by O. V. P. Stout, assisted by R. H. Willis. It is located at the highway bridge 1 mile south of Mitchell, Nebr. It replaces the station at Gering, Nebr., which was discontinued, as the narrower channel at Mitchell seemed favorable to increased accuracy of gagings, and, being nearer the Wyoming line, it serves better as a State-line gaging station. The gage is of the standard chain type. The scale is inclosed in a box fastened to the upstream hand rail near the center of the bridge. The length of the chain from the end of the weight to the marker is 10.60 feet. The gage is read once each day by J. L. McCoy.

On April 4, 1902, a temporary gage rod was set whose zero mark was 3.79 feet lower than the old rod of 1901. On May 3, 1902, a new permanent gage was put in whose zero mark was 1 foot lower than the old rod of 1901, in order to avoid negative gage heights. Hence, between April 4 and May 3, 1902, 2.79 feet was subtracted from the gage heights reported by the observer. To make the gage heights reported during 1901 comparable with those of 1902 and following years, 1 foot must be added.

Discharge measurements are made from the upstream side of the highway bridge, which is supported by pile bents 20 feet apart. The upstream hand rail is marked at intervals of 12½ feet with blue paint and at intervals of 10 feet with white paint. The initial point for soundings is the zero mark at the north end of the bridge. The channel is straight for 2,000 feet above and below the station. The mean velocity varies from 1 foot at low stages to 4 feet per second at high stages. Both banks are low and sandy, but are not liable to overflow. There is a rather large island in the gaging section. At high stages there are three channels, and at low stages there are from three to forty channels. The bridge has a total span of 1,565 feet. At low water the channels are too shallow for current-meter measurements, and at such times velocities must be estimated or determined with floats. Bench mark No. 1 is a cross cut in the floor of the bridge at the gage. Its elevation is 9.74 feet above gage datum. Bench mark No. 2 is the head of a nail driven in the top at the west end of the cap of the first bent at the north end of the bridge. Its elevation is 8.56 feet above gage datum. Bench mark No. 3 is a standard aluminum bench-mark cap of the Geological Survey leaded into the top of a 2-inch gas pipe 4 feet long, with a plate at the bottom. It is located 138 feet north of the north end of the bridge and 30 feet east of the line of the downstream hand rail extended. It is 2 feet outside of a wire fence. Its elevation is 8.64 feet above the gage datum. The gage datum is the water surface when the chain gage reads zero.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of North Platte River near Mitchell, Nebr., in 1904.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec. feet.* |
| March 29 | M. D. McWilliams | 679 | 1.88 | 2.30 | 1,273 |
| April 23 | J. C. Stevens | 931 | 2.03 | 2.58 | 1,890 |
| May 9 | M. D. McWilliams | 1,893 | 2.68 | 3.40 | 5,070 |
| May 23 | do | 3,659 | 3.25 | 4.74 | 11,890 |
| June 9 | J. C. Stevens | 3,207 | 3.46 | 4.60 | 11,100 |
| July 9 | do | 1,572 | 2.89 | 3.15 | 4,540 |
| September 27 | R. D. Hubbard | 115 | 1.90 | 1.75 | 219 |
| September 29 [a] | A. J. Parshall | 122 | 1.75 | 1.72 | 214 |
| September 30 [a] | do | 145 | 1.83 | 1.80 | 266 |

[a] Wading at different section.

*Mean daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1904.*

| Day. | Jan.[a] | Feb.[b] | Mar.[b] | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec.[c] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.08 | ..... | ..... | 2.22 | 2.75 | 4.30 | 3.30 | 2.12 | 1.97 | 1.75 | 1.87 | 1.81 |
| 2 | 2.00 | 2.50 | ..... | 2.15 | 2.80 | 4.50 | 3.28 | 2.16 | 1.93 | 1.72 | 1.86 | 1.83 |
| 3 | 1.95 | 2.25 | ..... | 2.14 | 2.84 | 4.40 | 3.40 | 2.13 | 1.90 | 1.70 | 1.85 | 1.86 |
| 4 | 1.85 | 2.20 | ..... | 2.32 | 2.94 | 4.60 | 3.07 | 2.12 | 1.95 | 1.73 | 1.80 | 1.78 |
| 5 | 2.03 | 2.22 | ..... | 2.30 | 3.70 | 4.35 | 3.00 | 2.10 | 1.93 | 1.75 | 1.86 | 1.71 |
| 6 | 1.97 | 2.23 | 2.53 | 2.27 | 3.90 | 4.50 | 3.15 | 2.11 | 1.95 | 1.70 | 1.87 | 1.73 |
| 7 | 1.85 | 2.20 | 2.45 | 2.25 | 3.84 | 4.70 | 3.23 | 2.15 | 1.97 | 1.75 | 1.88 | 1.72 |
| 8 | 1.90 | 2.15 | 2.60 | 2.27 | 3.70 | 4.80 | 3.20 | 2.09 | 1.93 | 1.77 | 1.89 | 1.71 |
| 9 | 2.12 | 2.17 | 2.55 | 2.18 | 3.58 | 4.75 | 3.15 | 2.11 | 1.90 | 1.70 | 1.86 | 1.72 |
| 10 | 1.87 | 2.25 | 2.57 | 2.17 | 3.49 | 4.73 | 3.10 | 2.11 | 1.95 | 1.75 | 1.88 | 1.74 |
| 11 | 2.10 | 2.20 | 2.55 | 2.18 | 3.45 | 4.60 | 3.05 | 2.08 | 1.85 | 1.73 | 1.89 | 1.75 |
| 12 | 2.00 | 2.23 | 2.50 | 2.15 | 3.40 | 4.40 | 3.00 | 2.02 | 1.87 | 1.76 | 1.98 | 1.77 |
| 13 | 2.15 | 2.19 | 2.47 | 2.20 | 3.37 | 4.55 | 2.90 | 2.00 | 1.85 | 1.70 | 1.97 | 1.80 |
| 14 | 2.12 | ..... | 2.45 | 2.25 | 3.35 | 4.60 | 2.85 | 2.05 | 1.90 | 1.75 | 1.96 | 1.78 |
| 15 | 2.25 | ..... | 2.43 | 2.19 | 3.33 | 4.35 | 2.75 | 2.07 | 1.92 | 1.70 | 1.98 | 1.76 |
| 16 | 2.15 | ..... | 2.45 | 2.20 | 3.37 | 4.20 | 2.63 | 2.00 | 1.95 | 1.73 | 1.97 | 1.73 |
| 17 | 2.30 | ..... | 2.47 | 2.18 | 3.45 | 4.30 | 2.60 | 2.01 | 1.90 | 1.75 | 1.95 | 2.30 |
| 18 | 2.37 | ..... | 2.46 | 2.13 | 3.47 | 4.40 | 2.59 | 2.05 | 1.89 | 1.72 | 1.93 | 2.30 |
| 19 | 2.35 | ..... | 2.47 | 2.10 | 3.48 | 4.30 | 2.58 | 1.95 | 1.92 | 2.05 | 1.94 | 2.30 |
| 20 | 2.38 | ..... | 2.45 | 2.40 | 3.45 | 4.50 | 2.55 | 2.00 | 1.85 | 2.00 | 1.95 | 2.00 |
| 21 | 2.40 | ..... | 2.47 | 2.60 | 3.72 | 4.40 | 2.53 | 2.03 | 1.87 | 1.95 | 1.97 | 1.90 |
| 22 | 2.45 | ..... | 2.43 | 2.58 | 3.67 | 4.15 | 2.50 | 1.95 | 1.83 | 1.92 | 1.89 | 1.80 |
| 23 | 2.45 | ..... | 2.42 | 2.60 | 4.90 | 4.20 | 2.48 | 1.97 | 1.85 | 1.90 | 1.87 | 1.77 |
| 24 | ..... | ..... | 2.38 | 2.65 | 4.90 | [d] 4.35 | 2.48 | 1.90 | 1.87 | 1.95 | 1.86 | 1.76 |
| 25 | ..... | ..... | 2.30 | 2.71 | 4.00 | [d] 4.50 | 2.45 | 1.95 | 1.83 | 1.93 | 1.85 | ..... |
| 26 | ..... | ..... | 2.34 | 2.75 | 4.30 | 4.65 | 2.42 | 1.93 | 1.80 | 1.95 | 1.87 | ..... |
| 27 | ..... | ..... | 2.32 | 2.80 | 4.20 | 4.57 | 2.45 | 1.94 | 1.82 | 1.90 | 1.88 | ..... |
| 28 | ..... | ..... | 2.35 | 2.79 | 4.50 | 4.40 | 2.40 | 1.92 | 1.79 | 1.88 | 1.84 | ..... |
| 29 | ..... | ..... | 2.33 | 2.81 | 4.10 | 4.30 | 2.35 | 1.93 | 1.75 | 1.92 | 1.85 | ..... |
| 30 | ..... | ..... | 2.30 | 2.82 | 4.80 | 3.90 | 2.30 | 1.90 | 1.77 | 1.92 | 1.83 | ..... |
| 31 | ..... | ..... | 2.32 | ..... | 4.50 | ..... | 2.26 | 1.94 | ..... | 1.87 | ..... | ..... |

[a] River frozen January 24 to February 1.
[b] River frozen February 14 to March 5.
[c] River frozen December 25 to 31.
[d] Gage height interpolated.

*Rating table for North Platte River near Mitchell, Nebr., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.60 | 70 | 2.60 | 2,175 | 3.60 | 6,205 | 4.60 | 11,080 |
| 1.70 | 170 | 2.70 | 2,535 | 3.70 | 6,655 | 4.70 | 11,610 |
| 1.80 | 280 | 2.80 | 2,905 | 3.80 | 7,115 | 4.80 | 12,150 |
| 1.90 | 400 | 2.90 | 3,285 | 3.90 | 7,580 | 4.90 | 12,700 |
| 2.00 | 540 | 3.00 | 3,675 | 4.00 | 8,055 | 5.00 | 13,255 |
| 2.10 | 710 | 3.10 | 4,075 | 4.10 | 8,540 | 5.10 | 13,820 |
| 2.20 | 930 | 3.20 | 4,485 | 4.20 | 9,030 | 5.20 | 14,395 |
| 2.30 | 1,200 | 3.30 | 4,905 | 4.30 | 9,530 | 5.30 | 14,975 |
| 2.40 | 1,505 | 3.40 | 5,330 | 4.40 | 10,040 | 5.40 | 15,565 |
| 2.50 | 1,830 | 3.50 | 5,765 | 4.50 | 10,555 | 5.50 | 16,165 |

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1904 and is fairly well defined.

*Estimated monthly discharge of North Platte River near Mitchell, Nebr., for 1904.*

[Drainage area, 24,400 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 1–23 [a] | 1,667 | 340 | 867 | 39,550 | 0.036 | 0.031 |
| February 2–13 | 1,830 | 820 | 1,029 | 24,490 | .042 | .019 |
| March 6–31 | 2,175 | 1,200 | 1,632 | 84,160 | .067 | .065 |
| April | 2,981 | 710 | 1,511 | 89,910 | .062 | .069 |
| May | 12,700 | 2,720 | 6,873 | 422,600 | .282 | .325 |
| June [b] | 12,150 | 7,580 | 10,270 | 611,100 | .421 | .470 |
| July | 5,330 | 1,092 | 2,875 | 176,800 | .118 | .136 |
| August | 842 | 400 | 594 | 36,520 | .024 | .028 |
| September | 498 | 225 | 382 | 22,730 | .016 | .018 |
| October | 625 | 170 | 307 | 18,880 | .013 | .015 |
| November | 512 | 280 | 398 | 23,680 | .016 | .018 |
| December | 1,200 | 181 | 381 | 18,140 | .016 | .014 |
| The period | | | | 1,569,000 | | |

[a] River frozen January 24 to February 1, also from February 14 to March 5 and from December 25 to 31.
[b] June 24 and 25 interpolated.

NORTH PLATTE RIVER NEAR BRIDGEPORT, NEBR.

This station was established May 4, 1902, by R. H. Willis. It is located at the highway bridge on the public road due north of Bridgeport. The Burlington and Missouri River Railroad bridge crosses the river 1 mile above the gaging station. The wire gage, with inclosed scale, is fastened to the upstream hand rail of the bridge at the south end. The length of the wire from the end of the weight to the marker is 12.80 feet. The gage is read once each day by Porter Hannawald. Discharge measurements are made from the upstream side of the highway bridge, which is supported by pile bents 20 feet apart. The hand rail is marked at 10-foot intervals with black paint, and the initial point for soundings is the zero mark on the hand rail at the south end of the bridge. The channel widens just above and below the station and is then straight for 1 mile above and one-half mile below. The water is never sluggish. Both banks are low and sandy, but are not liable to overflow. The bed is of shifting sand, free from vegetation. There is one channel at ordinary or high stages, but at low water the river is divided into many winding channels. The river generally goes dry in August. In sounding, during discharge measurements, care must be taken not to measure depths too close to the piles of the bridge supports, as there is usually a hole near the base of each filled with dead water. Bench mark No. 1 is a 6 by 6 inch stone, marked "U. S. C. & G. S.," located in the NE. ¼ sec. 32, T. 20 N., R. 50 W., of the sixth principal meridian. It is 300 feet east of the east gate of the stock yards and 130 feet northwest of the northwest corner of the public school building. Its elevation is 9.94 feet above gage datum. Bench mark No. 2 is a standard aluminum Geological Survey bench-mark cap set in a 20 by 12 by 6 inch stone, the top of which is built up with concrete to form a truncated pyramid. It is located about 50 feet south and a little east of the northeast corner of lot No. 4, block No. 2, of the Riverside Addition to Bridgeport, Nebr. Its elevation is 11.32 feet above gage datum. Bench mark No. 3 is the head of a nail driven in the top of the west end of the cap of the south bent of the bridge. Its elevation is 10.14 feet above gage datum. Gage datum is the water surface when the wire gage reads zero.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of North Platte River near Bridgeport, Nebr., in 1904.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| April 2 | M. D. Williams | 767 | 1.31 | 5.08 | 1,002 |
| April 23 | J. C. Stevens | 884 | 1.39 | 5.28 | 1,236 |
| May 26 | do | 3,006 | 2.62 | 6.17 | 7,878 |
| June 9 | do | 4,008 | 2.80 | 6.56 | 11,190 |
| July 9 | do | 1,922 | 2.33 | 5.76 | 4,486 |
| September 26 | R. D. Hubbard | 40 | 1.50 | 4.69 | 59 |

*Mean daily gage height, in feet, of North Platte River near Bridgeport, Nebr., for 1904.*

| Day. | Jan.[a] | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov.[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.60 | ..... | ..... | ..... | 5.45 | 6.46 | 6.05 | 4.90 | 4.82 | 4.92 | 5.02 |
| 2 | 5.55 | ..... | ..... | ..... | 5.43 | 6.46 | 5.92 | 4.82 | 4.75 | 4.85 | 5.00 |
| 3 | 5.90 | ..... | ..... | ..... | 5.52 | 6.46 | 6.04 | 4.75 | 4.73 | 4.82 | 5.02 |
| 4 | 5.80 | ..... | ..... | ..... | 5.60 | 6.55 | 5.92 | 4.74 | 4.72 | 4.72 | 5.00 |
| 5 | 5.35 | ..... | ..... | ..... | 5.65 | 6.32 | 5.74 | 4.73 | 4.72 | 4.75 | 5.00 |
| 6 | 5.40 | ..... | ..... | ..... | 6.05 | 6.29 | 5.76 | 4.79 | 4.70 | 4.75 | 4.95 |
| 7 | 5.45 | ..... | ..... | ..... | 6.31 | 6.48 | 5.88 | 4.84 | 4.70 | 4.75 | 4.95 |
| 8 | 5.42 | ..... | ..... | ..... | 6.25 | 6.66 | 5.76 | 4.75 | 4.67 | 4.75 | 5.15 |
| 9 | 5.40 | ..... | ..... | ..... | 5.88 | 6.68 | 5.79 | 4.75 | 4.60 | 4.70 | 5.20 |
| 10 | 5.42 | ..... | ..... | 5.20 | 5.82 | 6.56 | 5.86 | 4.72 | 4.62 | 4.75 | 5.00 |
| 11 | 5.40 | ..... | ..... | 5.10 | 6.01 | 6.56 | 5.80 | 4.70 | 4.63 | 4.72 | 4.90 |
| 12 | 5.40 | ..... | ..... | 5.05 | 5.74 | 6.59 | 5.56 | 4.68 | 4.63 | 4.75 | 4.92 |
| 13 | 5.42 | ..... | ..... | 5.03 | 5.72 | 6.38 | 5.55 | 4.64 | 4.64 | 4.78 | 5.05 |
| 14 | 5.48 | ..... | ..... | 5.03 | 5.72 | 6.42 | 5.48 | 4.64 | 4.65 | 4.80 | 5.20 |
| 15 | 5.50 | ..... | ..... | 5.25 | 5.82 | 6.34 | 5.49 | 4.65 | 4.65 | 4.78 | 5.17 |
| 16 | 5.42 | ..... | ..... | 4.98 | 5.74 | 6.34 | 5.40 | 4.75 | 4.65 | 4.80 | 5.15 |
| 17 | 5.40 | ..... | ..... | 5.15 | 5.75 | 6.31 | 5.32 | 4.85 | 4.67 | 4.75 | 5.10 |
| 18 | 5.42 | ..... | ..... | 5.05 | 5.80 | 6.38 | 5.31 | 4.95 | 4.67 | 4.80 | 5.12 |
| 19 | 5.43 | ..... | ..... | 5.03 | 5.80 | 6.28 | 5.30 | 4.88 | 4.70 | 5.35 | 5.10 |
| 20 | 5.50 | ..... | ..... | 5.05 | 5.86 | 6.38 | 5.25 | 4.72 | 4.68 | 5.30 | 5.12 |
| 21 | 5.55 | ..... | ..... | 5.07 | 5.92 | 6.36 | 5.22 | 4.72 | 4.68 | 5.10 | 5.15 |
| 22 | 5.42 | ..... | ..... | 5.35 | 5.95 | 6.26 | 5.21 | 4.75 | 4.70 | 5.05 | 5.08 |
| 23 | 5.42 | ..... | ..... | 5.20 | 6.36 | 6.30 | 5.25 | 4.70 | 4.70 | 5.00 | 5.17 |
| 24 | ..... | ..... | ..... | 5.75 | 6.58 | 6.31 | 5.24 | 4.72 | 4.72 | 5.25 | 5.13 |
| 25 | ..... | ..... | ..... | 5.25 | 6.22 | 6.29 | 5.25 | 4.72 | 4.70 | 5.08 | 5.07 |
| 26 | ..... | ..... | ..... | 5.32 | 6.20 | 6.31 | 5.25 | 4.70 | 4.70 | 5.00 | 5.00 |
| 27 | ..... | ..... | ..... | 5.20 | 6.22 | 6.22 | 5.25 | 4.75 | 4.70 | 4.95 | 5.35 |
| 28 | ..... | ..... | ..... | 5.50 | 6.35 | 6.12 | 5.22 | 4.60 | 4.72 | 4.98 | 5.32 |
| 29 | ..... | ..... | ..... | 5.48 | 6.38 | 6.04 | 5.05 | 4.65 | 4.78 | 5.00 | 5.00 |
| 30 | ..... | ..... | ..... | 5.45 | 6.57 | 6.02 | 4.95 | 4.70 | 4.87 | 4.98 | ..... |
| 31 | ..... | ..... | ..... | ..... | 6.50 | ..... | 5.04 | 4.75 | ..... | 5.00 | ..... |

[a] River frozen January.
[b] Slush ice during November.

*Rating table for North Platte River near Bridgeport, Nebr., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.60 | 50 | 5.20 | 1,200 | 5.80 | 4,800 | 6.30 | 9,000 |
| 4.70 | 100 | 5.30 | 1,610 | 5.90 | 5,640 | 6.40 | 9,840 |
| 4.80 | 200 | 5.40 | 2,090 | 6.00 | 6,480 | 6.50 | 10,680 |
| 4.90 | 360 | 5.50 | 2,640 | 6.10 | 7,320 | 6.60 | 11,520 |
| 5.00 | 580 | 5.60 | 3,280 | 6.20 | 8,160 | 6.70 | 12,360 |
| 5.10 | 860 | 5.70 | 4,000 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly defined. Above gage height 5.8 feet the rating curve is a tangent, the difference being 8.40 per tenth.

*Estimated monthly discharge of North Platte River near Bridgeport, Nebr., for 1904.*

[Drainage area, 23,190 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April 10–30 | 4,400 | 536 | 1,393 | 58,020 | 0.060 | 0.047 |
| May | 11,350 | 2,255 | 6,313 | 388,200 | .272 | .314 |
| June | 12,190 | 6,648 | 9,630 | 573,000 | .415 | .463 |
| July | 6,900 | 470 | 2,940 | 180,800 | .127 | .146 |
| August | 470 | 50 | 157 | 9,654 | .0068 | .0078 |
| September | 312 | 50 | 108 | 6,426 | .0047 | .0052 |
| October | 1,850 | 100 | 464 | 28,530 | .020 | .023 |
| November 1–29 [a] | 1,850 | 360 | 846 | 48,660 | .036 | .039 |
| The period | | | | 1,293,000 | | |

[a] Some slush ice in November; above estimate is for open channel. The above monthly estimate is only a rough approximation on account of insufficient measurements and shifting stream bed.

## NORTH PLATTE RIVER AT NORTH PLATTE, NEBR.

The lowest gaging station on this river is located at the wagon bridge just north of North Platte, Nebr., and was established October 5, 1894. It is 3½ miles above the junction with South Platte River, in sec. 28, T. 14 N., R. 30 W. The bridge is a long, low, pile structure, having 93 spans of approximately 20 feet each, crossing the main channel of the river. North of this, at a distance of about 440 feet, is another bridge crossing a smaller branch or slough and having six spans of

about 20 feet each. The water, except in times of flood, does not pass under all of the spans of the long bridge. Usually, the greater part flows under two or three of the spans, spreading out in shallow pools or streamlets under others. Beneath the greater number of spans is a dry, sandy bed at ordinary stages. The initial point for soundings is on the right bank and consists of a mark on the railing on the upstream side of the bridge. The channel is nearly straight for about 500 feet both above and below the station. The banks are low, but are rarely, if ever, overflowed. The current is moderately rapid, and the bed is sandy and shifting.

The observations of river height are made at the Union Pacific Railroad bridge, about 2 miles below the wagon-road bridge. The railroad bridge is 2 miles above the junction of North and South Platte rivers. The gage is vertical, marked to tenths of a foot, and is fastened by screws to the piling under the bridge. The gage is read twice each day by H. E. Dress, the railroad bridge watchman.

The bench mark is the top of the east rail directly over the gage rod. Its elevation is 12.00 feet above the zero of the gage. The river usually goes dry some time in August. In measuring depths care must be taken not to sound too close to the piling, as there is usually a hole washed out around the base of each, in which there is no current.

It has been the practice, since the gage rod is some distance below the gaging section and the gage height can not be taken simultaneously with the discharge measurement, to reference the water surface both at beginning and end of the measurement to a bench mark at the gaging section, thus obtaining relative differences in the gage height for successive gagings, for a check on the height observed at the gage rod two miles below.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements on North Platte River at North Platte, Nebr., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet* | *Sec. feet.* |
| March 26[a] | J. C. Stevens | 1,000 | 545 | 2.00 | 2.20 | 1,086 |
| May 13 | do | | 2,030 | 2.46 | 2.80 | 4,995 |
| May 27 | R. D. Hubbard | 1,900 | 3,142 | 3.01 | 3.40 | 9,445 |
| June 13 | J. C. Stevens | | 4,659 | 3.14 | 3.85 | 14,620 |
| July 26 | do | | 773 | 1.92 | 2.05 | 1,488 |
| September 28 | R. D. Hubbard | | 262 | 1.61 | 1.57 | 422 |

[a] Considerable ice running in channel. North half of channel frozen.

*Mean daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1904.*

| Day. | Jan.[a] | Feb.[a] | Mar.[a] | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec.[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.70 | ..... | 2.80 | 2.40 | 2.60 | 3.50 | 2.83 | 1.73 | 1.32 | 2.12 | 2.02 | 2.22 |
| 2 | 2.50 | ..... | 2.50 | 2.30 | 2.60 | 3.55 | 2.85 | 1.75 | 1.78 | 2.08 | 1.98 | 2.25 |
| 3 | 2.45 | ..... | 1.50 | 2.30 | 2.58 | 3.65 | 2.98 | 1.90 | 1.48 | 1.98 | 1.95 | 2.25 |
| 4 | 2.50 | ..... | 1.60 | 2.30 | 2.75 | 3.57 | 2.88 | 1.95 | 1.62 | 1.92 | 1.95 | 2.08 |
| 5 | 2.65 | ..... | 1.60 | 2.30 | 2.85 | 3.43 | 2.80 | 1.77 | 1.48 | 1.75 | 1.98 | 2.05 |
| 6 | 2.70 | ..... | 2.20 | 2.30 | 2.78 | 3.33 | 2.95 | 2.20 | 1.35 | 1.75 | 2.00 | 2.10 |
| 7 | 2.70 | ..... | 2.35 | 2.00 | 2.63 | 3.30 | 3.13 | 1.85 | 1.30 | 1.78 | 2.00 | 2.12 |
| 8 | 2.65 | ..... | 2.40 | 2.50 | 2.63 | 3.28 | 2.97 | 1.80 | 1.18 | 1.70 | 1.98 | 2.20 |
| 9 | 2.75 | ..... | 2.60 | 2.10 | 3.03 | 3.45 | 3.00 | 1.67 | 1.12 | 1.82 | 1.90 | 2.22 |
| 10 | 2.80 | ..... | 2.55 | 2.25 | 3.03 | 3.57 | 2.80 | 1.60 | 1.05 | 1.80 | 1.90 | 2.30 |
| 11 | 2.80 | ..... | 2.45 | 2.10 | 2.93 | 3.60 | 2.92 | 1.55 | 1.05 | 1.78 | 1.92 | 2.30 |
| 12 | 2.80 | ..... | 2.30 | 1.95 | 2.83 | 3.55 | 2.80 | 1.43 | 1.08 | 1.78 | 2.00 | 2.30 |
| 13 | 2.80 | ..... | 2.35 | 2.10 | 2.80 | 3.85 | 2.73 | 1.44 | 1.05 | 1.62 | 2.15 | 2.55 |
| 14 | 2.80 | ..... | 2.50 | 2.15 | 2.78 | 3.92 | 2.70 | 1.35 | 1.05 | 1.62 | 2.08 | 2.60 |
| 15 | 2.80 | ..... | 2.50 | 2.10 | 2.73 | 3.75 | 2.68 | 1.30 | 1.08 | 1.62 | 1.98 | ..... |
| 16 | 2.90 | ..... | 2.40 | 1.95 | 2.68 | 3.75 | 2.50 | 1.27 | 1.05 | 1.65 | 2.02 | ..... |
| 17 | 2.90 | ..... | 2.40 | 2.05 | 2.75 | 3.60 | 2.40 | 1.23 | 1.05 | 1.65 | 2.15 | ..... |
| 18 | 2.90 | ..... | 2.35 | 2.00 | 2.75 | 3.50 | 2.35 | 1.25 | 1.05 | 1.85 | 2.10 | ..... |
| 19 | 2.85 | ..... | 2.25 | 1.85 | 2.68 | 3.50 | 2.25 | 1.25 | 1.00 | 2.08 | 2.10 | ..... |
| 20 | 2.70 | ..... | 2.30 | 1.90 | 2.68 | 3.45 | 2.40 | 1.20 | .95 | 2.02 | 2.02 | ..... |
| 21 | 2.70 | ..... | 2.30 | 1.95 | 2.73 | 3.45 | 2.27 | 1.15 | 1.08 | 1.98 | 2.00 | ..... |
| 22 | 2.80 | ..... | 2.35 | 2.05 | 2.80 | 3.40 | 2.20 | 1.12 | 1.08 | 1.90 | 2.00 | ..... |
| 23 | 2.80 | ..... | 2.50 | 1.95 | 2.80 | 3.45 | 2.22 | 1.10 | 1.15 | 1.82 | 2.05 | ..... |
| 24 | 2.80 | ..... | 2.40 | 1.95 | 2.85 | 3.38 | 2.25 | 1.05 | 1.08 | 1.92 | 2.12 | ..... |
| 25 | 2.80 | ..... | 2.20 | 1.90 | 2.85 | 3.33 | 2.10 | 1.10 | 1.08 | 2.10 | 2.15 | ..... |
| 26 | 2.75 | ..... | 2.20 | 2.20 | 3.58 | 3.25 | 2.05 | 1.10 | 1.08 | 2.10 | 2.10 | ..... |
| 27 | 2.65 | ..... | 2.30 | 2.30 | 3.35 | 3.15 | 2.00 | 1.10 | 1.15 | 2.08 | 2.08 | ..... |
| 28 | 2.60 | 3.75 | 2.40 | 2.30 | 3.25 | 3.05 | 1.95 | 1.10 | 1.40 | 2.08 | 2.05 | ..... |
| 29 | 2.70 | 3.30 | 2.20 | 2.35 | 3.25 | 3.05 | 2.02 | 1.20 | 1.48 | 2.08 | 2.00 | ..... |
| 30 | 2.55 | ..... | 2.25 | 2.45 | 3.30 | 3.05 | 1.80 | 1.18 | 1.80 | 2.10 | 2.05 | ..... |
| 31 | ..... | ..... | 2.40 | ..... | 3.30 | ..... | 1.75 | 1.20 | ..... | 2.05 | ..... | ..... |

[a] Ice conditions January, February, March, and December.

*Rating table for North Platte River at North Platte, Nebr., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.95 | 20 | 1.70 | 690 | 2.50 | 3,360 | 3.30 | 8,650 |
| 1.00 | 25 | 1.80 | 910 | 2.60 | 3,870 | 3.40 | 9,560 |
| 1.10 | 40 | 1.90 | 1,150 | 2.70 | 4,420 | 3.50 | 10,530 |
| 1.20 | 80 | 2.00 | 1,420 | 2.80 | 5,010 | 3.60 | 11,580 |
| 1.30 | 140 | 2.10 | 1,725 | 2.90 | 5,640 | 3.70 | 12,700 |
| 1.40 | 230 | 2.20 | 2,070 | 3.00 | 6,310 | 3.80 | 13,900 |
| 1.50 | 350 | 2.30 | 2,460 | 3.10 | 7,030 | 3.90 | 15,200 |
| 1.60 | 500 | 2.40 | 2,890 | 3.20 | 7,810 | 4.00 | 16,600 |

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is not well defined.

*Estimated monthly discharge of North Platte River at North Platte, Nebr., for 1904.*

[Drainage area, 28,520 square miles.]

| Month.[a] | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 3,360 | 1,030 | 1,938 | 115,300 | 0.068 | 0.076 |
| May | 11,370 | 3,768 | 5,644 | 347,000 | .198 | .228 |
| June | 15,480 | 6,670 | 10,260 | 610,500 | .360 | .402 |
| July | 7,264 | 800 | 3,681 | 226,300 | .129 | .149 |
| August | 2,070 | 32 | 399 | 24,530 | .014 | .016 |
| September | 910 | 20 | 159 | 9,461 | .0056 | .0062 |
| October | 1,794 | 538 | 1,167 | 71,760 | .041 | .047 |
| November | 1,898 | 1,150 | 1,517 | 90,270 | .053 | .059 |
| The period | | | | 1,495,000 | | |

[a] Ice conditions January, February, March, and December.

NOTE.—Insufficient measurements were made during 1904 to make the above monthly estimate other than a rough approximation.

## PLATTE RIVER NEAR LEXINGTON, NEBR.

This station was established April 2, 1902, by H. O. Smith. It is located in sec. 20, T. 9 N., R. 21 W., at the highway bridge 3 miles south of Lexington, Nebr., shown on the Lexington quadrangle.

Discharge measurements are made from the upstream side of the highway bridge, which consists of 187 20-foot spans supported by pile bents. A second smaller channel, about one-fourth mile south, is measured from a similar pile bridge having a total span of 60 feet. The upstream hand rail at the main bridge is marked at 20-foot intervals. The initial point for soundings is the zero mark on the hand rail at the north or left bank of the stream. The channel is straight 1 mile above and below the station. The section is broad and shallow with a rapid velocity and shifting, sandy bed. Both banks are low but not liable to overflow. The river usually goes dry in August. At low stages the river flows in as many as 40 channels of varying widths and depths, and it is impracticable to measure the discharge at such stages with a fair degree of accuracy. It has been done, however, by preparing the channel beforehand—that is, by throwing up small dikes of sand where necessary to throw the small winding channels into ones of sufficient size to enable velocities to be measured with a current meter.

During 1902 and 1903 a single boxed-wire gage, located near the left bank, was employed for the observation of gage heights. It was

noticed, however, that on account of the extreme width—3,720 feet—and shallowness of the stream the effect of wind velocities on the gage heights was very considerable. In order to eliminate this effect as much as possible two gages of the regulation chain and weight type were installed in the spring of 1904, one at the north end downstream side and the other at the south end upstream side of bridge with their zeros at the same elevation, and Mr. E. J. Duryee, a mail carrier, was employed to read both gages in crossing, no observations being taken on Sundays or holidays. The gage heights employed in the preparation of daily discharge tables therefore are the mean of the heights observed at each gage.

Bench mark No. 2 is the top of the east end of the first cap at the north end of the bridge. Its elevation is 7.66 above gage datum. Bench marks Nos. 3 and 4 are the tops of the upstream ends of the caps of the third bent from the north and south ends of the bridge, respectively, each marked with a cross. Their elevations are respectively 9.22 and 9.03 feet above gage datum.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of Platte River near Lexington, Nebr., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 27 | J. C. Stevens | | 1,708 | 1.80 | 3.34 | 3,070 |
| May 14 | do | | 2,504 | 1.89 | 3.54 | 4,731 |
| May 27 | do | 3,793 | 4,656 | 2.28 | 4.10 | 10,610 |
| June 14 | do | 3,810 | 6,760 | 2.83 | 4.48 | 19,100 |
| July 27 | do | | 1,046 | 1.61 | 3.32 | 1,690 |
| September 1 | do | | 83 | 1.50 | 2.99 | 125 |

*Mean daily gage height, in feet, of Platte River near Lexington, Nebr., for 1904.*

| | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 3.14 | ..... | 4.00 | 3.85 | 3.19 | 3.00 | 3.22 | 3.35 |
| 2 | ..... | 3.28 | 3.14 | 4.12 | 3.78 | 3.18 | 3.05 | ..... | 3.36 |
| 3 | ..... | ..... | 3.20 | 4.15 | ..... | 3.25 | 3.02 | 3.32 | 3.34 |
| 4 | ..... | 3.22 | 3.58 | 4.20 | ..... | 3.20 | ..... | 3.28 | 3.32 |
| 5 | ..... | 3.20 | 3.70 | ..... | 3.88 | 3.29 | 3.05 | 3.10 | 3.38 |
| 6 | ..... | 3.29 | 3.60 | 4.11 | 3.78 | 3.18 | 3.02 | 3.18 | ..... |
| 7 | ..... | 3.32 | 3.56 | 4.05 | 3.88 | ..... | 3.02 | 3.22 | 3.30 |
| 8 | ..... | ..... | ..... | 4.00 | 3.85 | 3.32 | 2.98 | 3.10 | 3.30 |
| 9 | ..... | 3.05 | 3.45 | 4.02 | 3.72 | 3.22 | 2.92 | ..... | 3.35 |
| 10 | ..... | ..... | 3.65 | 4.28 | ..... | 3.20 | 2.90 | 3.12 | 3.48 |
| 11 | ..... | 3.25 | 3.70 | 4.32 | 3.60 | 3.15 | ..... | 3.12 | 3.25 |
| 12 | ..... | 3.10 | 3.68 | ..... | 3.65 | 3.08 | 2.92 | 3.15 | 3.28 |
| 13 | ..... | 3.10 | 3.52 | 4.50 | 3.60 | 3.00 | 3.18 | 3.18 | ..... |
| 14 | ..... | 2.98 | 3.55 | 4.42 | 3.55 | ..... | 3.00 | 3.20 | 3.38 |
| 15 | ..... | 3.19 | ..... | 4.42 | 3.55 | 2.92 | 2.82 | 3.20 | 3.40 |
| 16 | ..... | 3.10 | ..... | 4.35 | 3.50 | 2.90 | 2.80 | ..... | 3.35 |
| 17 | ..... | ..... | 3.50 | 4.48 | ..... | 2.82 | 2.75 | 3.12 | 3.32 |
| 18 | ..... | 3.06 | 3.55 | 4.25 | 3.40 | 3.22 | ..... | 3.30 | 3.35 |
| 19 | ..... | 3.02 | 3.55 | ..... | 3.35 | 3.10 | 2.70 | 3.40 | 3.40 |
| 20 | ..... | 3.08 | 3.52 | 4.24 | 3.40 | 2.92 | (a) | 3.35 | ..... |
| 21 | ..... | 3.06 | 3.45 | 4.20 | 3.40 | 2.88 | (a) | 3.38 | 3.35 |
| 22 | ..... | 3.14 | ..... | 4.22 | 3.38 | 2.68 | (a) | 3.35 | 3.35 |
| 23 | ..... | 3.15 | 3.38 | 4.10 | 3.42 | 2.58 | (a) | ..... | 3.35 |
| 24 | ..... | ..... | 3.50 | 4.16 | ..... | (a) | 2.85 | 3.35 | ..... |
| 25 | ..... | 2.98 | 3.40 | 4.18 | 3.32 | (a) | ..... | 3.28 | 3.42 |
| 26 | ..... | 2.98 | 3.55 | ..... | 3.32 | (a) | 2.80 | 3.28 | 3.42 |
| 27 | ..... | 3.08 | 4.10 | 4.10 | 3.32 | (a) | 2.75 | 3.35 | ..... |
| 28 | 3.32 | 3.20 | 3.88 | 4.00 | 3.32 | (a) | 3.15 | 3.30 | 3.45 |
| 29 | 3.22 | 3.12 | ..... | 3.98 | 3.28 | 3.25 | 3.10 | 3.28 | 3.38 |
| 30 | 3.15 | 3.12 | 3.84 | 3.92 | 3.20 | 3.12 | 3.15 | ..... | 3.38 |
| 31 | 3.18 | ..... | 3.92 | ..... | ..... | 3.10 | ..... | 3.32 | ..... |

[a] No water flowing.

*Rating table for Platte River near Lexington, Nebr., from May 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.00 | 200 | 3.40 | 2,700 | 3.80 | 6,500 | 4.20 | 12,600 |
| 3.10 | 750 | 3.50 | 3,500 | 3.90 | 7,700 | 4.30 | 14,700 |
| 3.20 | 1,350 | 3.60 | 4,400 | 4.00 | 9,100 | 4.40 | 17,000 |
| 3.30 | 2,000 | 3.70 | 5,400 | 4.10 | 10,700 | 4.50 | 19,500 |

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined. The discharge below gage height 3 feet is approximate.

*Estimated monthly discharge of Platte River near Lexington, Nebr., for 1904.*

[Drainage area, 53,300 square miles.]

| Month.[a] | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April[b] | 2,000 | 1,000 | 1,218 | 72,480 | 0.023 | 0.026 |
| May | 10,700 | 1,025 | 4,295 | 264,100 | .081 | .093 |
| June | 19,500 | 7,700 | 12,570 | 748,000 | .236 | .263 |
| July | 7,700 | 1,350 | 4,071 | 250,300 | .076 | .088 |
| August | 2,000 | 0 | 760 | 46,730 | .014 | .016 |
| September | 1,350 | 0 | 266 | 15,830 | .0050 | .0056 |
| October | 2,700 | 750 | 1,662 | 102,200 | .031 | .036 |
| November[c] | 3,100 | 1,600 | 2,392 | 142,300 | .045 | .050 |
| The period | | | | 1,642,000 | | |

[a] Owing to the shifting condition of the stream bed and insufficient measurement during 1904 the above estimates can only be considered a very rough approximation.
[b] Daily discharge during April obtained by indirect method.
[c] November 10, river frozen; discharge estimated. Discharges for Sundays and holidays interpolated.

## PLATTE RIVER NEAR COLUMBUS, NEBR.

This station was established June 4, 1895, by O. V. P. Stout, at the Meridian Bridge, 2 miles south of Columbus, Nebr. The gage is of the regulation chain and weight type, whose boxed scale is fastened to the downstream hand rail of the north bridge approach. The distance from the end of the weight to the index is 16.21 feet. The river at this point flows in three channels, known as the main, middle, and south channels, having widths of 1,940 feet, 320 feet, and 75 feet, respectively. Each channel is spanned by a pile bridge, from the upstream side of which discharge measurements are made. The main channel is crossed by the Meridian Bridge, which consists of sixty-five 30-foot spans. The middle channel bridge consists of sixteen 20-foot spans, and is located 1⅛ miles south of the Meridian Bridge. The south channel is spanned by a pile bridge about 80 feet long, located one-eighth mile south of the middle channel bridge. Discharge measurements are made from the upstream side of all three bridges, whose hand rails are marked at intervals of 10 or 20 feet. The initial point for soundings is the zero mark on the upstream hand rail at the north end of the main channel bridge, and at the south ends of the middle and south channel bridges. Above the bridges the channels are straight for 5,000 feet in the main channel, 200 feet in the middle channel, and 100 feet in the south channel. Below the bridges the channels are straight for 3,000 feet in the main channel, 300 feet in the middle channel, and 500 feet in the south channel. The

sections are broad and shallow, with rapid velocity and shifting, sandy bed. At low stages the river flows in many shallow channels, so that the measurement of the discharge is mainly a matter of estimation. The bed is so changeable that the daily discharges are not proportional to the corresponding gage heights. The method of applying corrections to observed gaged heights in the preparation of daily discharge tables, as outlined in Nineteenth Annual Report of the U. S. Geological Survey, Part IV, p. 323 et seq., has been resorted to. The river is usually dry from August 15 to October 15. Bench mark No. 1 is a standard iron post of the Geological Survey, located 60 feet north of the north end of the north bridge truss, and 10 feet west of a cottonwood tree 6 feet in diameter. Its elevation is 7.06 feet above the zero of the gage. Bench mark No. 2 is the heads of three spikes driven into the top of the second piling from the downstream end of the second bent from the north end of bridge, counting approach bent one. Its elevation is 9.62 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of Platte River near Columbus, Nebr., in 1904.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 8 | J. C. Stevens | 2,571 | 2.23 | 3.85 | 5,747 |
| June 19 | do | 5,060 | 3.00 | 4.52 | 15,190 |
| June 25 | do | 4,107 | 2.92 | 4.13 | 12,020 |
| July 28 | do | 1,435 | 1.77 | 2.96 | 2,549 |
| September 2 | O. H. Timmerman | 40 | 1.50 | 1.91 | 60 |

*Mean daily gage height, in feet, of Platte River near Columbus, Nebr., for 1904.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 3.20 | 2.60 | 4.15 | 3.91 | 2.53 | 1.87 | 2.05 | 2.40 |
| 2 | ..... | 3.20 | 2.60 | 4.20 | 3.81 | 2.35 | 1.80 | 2.00 | 2.35 |
| 3 | ..... | 3.15 | 2.60 | 4.65 | 3.76 | 2.40 | 1.65 | 1.80 | 2.30 |
| 4 | ..... | 3.20 | 2.65 | 4.75 | 3.75 | 2.42 | 1.65 | 1.80 | 2.35 |
| 5 | ..... | 3.20 | 2.65 | 4.85 | 3.75 | 2.32 | 1.70 | 1.25 | 2.35 |
| 6 | ..... | 3.10 | 3.00 | 4.65 | 3.80 | 2.29 | 1.80 | 1.20 | 2.35 |
| 7 | ..... | 3.10 | ..... | 4.55 | 3.95 | 2.26 | 1.70 | 1.30 | 2.40 |
| 8 | ..... | 3.30 | 3.80 | 4.45 | 4.02 | 2.21 | 1.65 | 2.00 | 2.40 |
| 9 | ..... | 3.20 | 3.75 | 4.35 | 4.00 | 2.40 | 1.53 | 2.25 | 2.30 |
| 10 | ..... | 3.05 | 3.75 | 4.10 | 3.85 | 2.85 | 1.46 | 2.45 | 2.20 |
| 11 | ..... | 3.05 | 3.80 | 4.18 | 4.20 | 2.85 | 1.30 | 2.25 | 2.10 |
| 12 | ..... | 3.00 | 3.85 | 4.35 | 3.97 | 2.70 | 1.12 | 2.15 | 2.00 |
| 13 | 3.20 | 2.90 | 3.85 | 4.90 | 3.80 | 2.52 | 1.55 | 2.20 | 2.20 |
| 14 | 3.10 | 2.90 | 3.90 | 5.00 | 3.50 | 2.40 | 1.55 | 2.30 | 2.30 |
| 15 | 3.10 | 2.80 | 3.60 | 4.60 | 3.42 | 2.25 | 1.35 | 2.40 | 2.30 |
| 16 | 3.00 | 2.80 | 3.70 | 4.92 | 3.35 | 2.15 | 1.35 | 2.35 | 2.40 |
| 17 | 3.00 | 2.75 | 3.60 | 4.80 | 3.70 | 1.95 | 1.35 | 2.35 | 2.55 |
| 18 | 3.00 | 2.75 | 3.66 | 4.50 | 3.31 | 2.12 | 1.30 | 2.40 | 2.55 |
| 19 | 3.00 | 2.70 | 3.65 | 4.52 | 3.20 | 2.15 | 1.30 | 2.45 | 2.45 |
| 20 | 3.25 | 2.70 | 3.65 | 4.25 | 3.26 | 2.17 | 1.25 | 2.83 | 2.42 |
| 21 | 3.30 | 2.65 | 3.60 | 4.20 | 3.27 | 2.08 | 1.50 | 3.10 | 2.40 |
| 22 | 3.30 | 2.60 | 3.50 | 4.20 | 3.25 | 1.92 | 1.55 | 3.10 | 2.40 |
| 23 | 3.30 | 2.60 | 3.38 | 4.10 | 3.17 | 1.65 | 1.40 | 3.25 | 2.40 |
| 24 | 3.20 | 2.60 | 3.35 | 4.10 | 3.20 | 1.55 | 1.40 | 2.95 | 2.35 |
| 25 | 3.10 | 3.00 | ..... | 4.20 | 3.15 | 1.45 | 1.40 | 2.90 | 2.40 |
| 26 | 3.00 | 3.25 | 3.30 | 4.55 | 3.10 | 1.35 | 1.45 | 2.70 | 2.40 |
| 27 | 3.10 | 3.45 | 3.40 | 4.50 | 3.03 | 1.30 | 1.45 | 2.60 | ..... |
| 28 | 3.10 | 3.20 | 3.60 | 4.25 | 2.95 | 1.35 | 1.50 | 2.40 | ..... |
| 29 | 3.10 | 2.90 | 3.70 | 4.12 | 3.00 | 1.40 | 1.60 | 2.35 | ..... |
| 30 | 3.10 | 2.75 | 4.20 | 4.00 | 2.91 | 1.45 | 1.75 | 2.30 | ..... |
| 31 | 3.10 | ..... | 4.10 | ..... | 2.73 | 2.00 | ..... | 2.35 | ..... |

*Rating table for Platte River near Columbus, Nebr., from June 15 to October 27, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 0 | 2.60 | 1,080 | 3.50 | 6,970 | 4.30 | 13,290 |
| 1.80 | 20 | 2.70 | 1,400 | 3.60 | 7,760 | 4.40 | 14,080 |
| 1.90 | 50 | 2.80 | 1,800 | 3.70 | 8,550 | 4.50 | 14,870 |
| 2.00 | 110 | 2.90 | 2,350 | 3.80 | 9,340 | 4.60 | 15,660 |
| 2.10 | 200 | 3.00 | 3,050 | 3.90 | 10,130 | 4.70 | 16,450 |
| 2.20 | 320 | 3.10 | 3,810 | 4.00 | 10,920 | 4.80 | 17,240 |
| 2.30 | 460 | 3.20 | 4,600 | 4.10 | 11,710 | 4.90 | 18,030 |
| 2.40 | 630 | 3.30 | 5,390 | 4.20 | 12,500 | 5.00 | 18,820 |
| 2.50 | 830 | 3.40 | 6,180 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904. It is only a rough approximation. Above gage height 3.1 feet the rating curve is a tangent, the difference being 790 per tenth.

*Estimated monthly discharge of Platte River near Columbus, Nebr., for 1904.*[a]

[Drainage area, 56,870 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| May 8–31 | 8,550 | 1,250 | 4,128 | 196,500 | 0.073 | 0.065 |
| June | 18,190 | 7,760 | 12,880 | 766,400 | .226 | .252 |
| July | 12,500 | 1,520 | 6,888 | 423,500 | .121 | .140 |
| August | 2,075 | 0 | 451 | 27,730 | .0079 | .0091 |
| September | 41 | 0 | 3.03 | 180 | | |
| October | 4,995 | 0 | 1,037 | 63,760 | .018 | .021 |
| November 1–26 | 1,000 | 1,000 | 1,000 | 51,570 | .018 | .017 |
| The period | | | | 1,530,000 | | |

[a] Estimates May 8 to June 14 and Oct. 28 to Nov. 26 obtained by indirect method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, page 323 et seq.

## BIG GRIZZLY CREEK AT HEBRON, COLO.

This station was established May 13, 1904, by M. C. Hinderlider. It is located at the highway bridge at Hebron, Colo., about 2 miles above the junction of Big and Little Grizzly creeks and 10 miles from Walden, Colo. A plain, vertical, staff gage, graduated to feet and tenths from 2 feet to 9.5 feet, is spiked to the left downstream corner of the middle crib pier. The 2-foot mark rests upon the bed of the stream. The gage is read twice each day by James R. Peterson. Discharge measurements are made at low and ordinary stages by wading near the gage. During very high water measurements are made from the downstream side of the 2-span bridge to which the gage is attached. The bridge is marked every 2 feet and figures cut every 4 feet in the top of the downstream hand rail. The initial point for soundings is the face of the left abutment at the zero marked on the hand rail. The channel is straight for about 50 feet above and below the station and the current is at right angles to the gaging section. The current is uniform and medium at all stages. Both banks are about 3 feet high, clean, and not subject to overflow. The bed of the stream is composed of gravel, with cobblestones and mud on the left side of the stream. It is fairly uniform and permanent. Bench mark No. 1 is a 30-penny nail driven vertically into the top of the downstream end of the top timber of the left abutment of the bridge. Its elevation is 9.76 feet above gage datum. Bench mark No. 2 is a regulation iron bench-mark post, 4 feet east of the fence on the west side of the road, 60 feet south of the river bank. Its elevation is 8.817 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Big Grizzly Creek at Hebron, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 13 [a] | W. A. Lamb | 35 | 58 | 2.28 | 4.76 | 132 |
| May 26 | do | 47 | 101 | 2.95 | 5.64 | 298 |
| June 2 | do | 45 | 75 | 2.51 | 5.15 | 188 |
| June 13 | do | 37 | 66 | 2.33 | 4.96 | 154 |
| June 27 | do | 32 | 33 | 1.73 | 4.25 | 57 |
| July 12 | do | 18 | 10 | 1.40 | 3.66 | 14 |
| August 8 | do | 14 | 5 | .60 | 3.40 | 3 |

[a] Wading 50 feet below station.

*Mean daily gage height, in feet, of Big Grizzly Creek at Hebron, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 5.30 | 3.92 | 3.40 | 3.65 | 3.70 |
| 2 | ..... | 5.12 | 3.88 | 3.42 | 3.65 | 3.65 |
| 3 | ..... | 5.35 | 3.70 | 3.45 | 3.65 | 3.55 |
| 4 | ..... | 5.95 | 3.75 | 3.40 | 3.60 | 3.55 |
| 5 | ..... | 5.32 | 3.75 | 3.40 | 3.60 | 3.55 |
| 6 | ..... | 5.30 | 3.75 | 3.42 | 3.60 | 3.55 |
| 7 | ..... | 4.75 | 3.70 | 3.42 | 3.65 | 3.60 |
| 8 | ..... | 4.82 | 3.78 | 3.42 | 3.65 | 3.55 |
| 9 | ..... | 5.32 | 3.75 | 3.40 | 3.60 | 3.52 |
| 10 | ..... | 5.20 | 3.70 | 3.40 | 3.60 | 3.55 |
| 11 | ..... | 5.12 | 3.75 | 3.55 | 3.50 | 3.55 |
| 12 | ..... | 5.10 | 3.62 | 3.95 | 3.50 | 3.60 |
| 13 | 4.88 | 5.25 | 3.58 | 3.90 | 3.50 | 3.65 |
| 14 | 4.82 | 5.25 | 3.58 | 3.90 | 3.50 | 3.70 |
| 15 | 4.85 | 5.22 | 3.62 | 3.90 | 3.40 | 3.75 |
| 16 | 4.85 | 5.00 | 3.58 | 4.00 | 3.40 | 3.70 |
| 17 | 4.72 | 4.95 | 3.48 | 3.95 | 3.40 | 3.70 |
| 18 | 4.80 | 4.80 | 3.52 | 3.95 | 3.40 | 3.75 |
| 19 | 4.90 | 4.95 | 3.50 | 3.90 | 3.45 | 3.75 |
| 20 | 4.98 | 4.95 | 3.50 | 3.75 | 3.45 | 3.70 |
| 21 | 5.30 | 4.68 | 3.50 | 3.70 | 3.50 | 3.70 |
| 22 | 5.35 | 4.75 | 3.50 | 3.60 | 3.50 | 3.70 |
| 23 | 5.35 | 4.58 | 3.50 | 3.60 | 3.55 | 3.75 |
| 24 | 5.58 | 4.50 | 3.50 | 3.60 | 3.55 | 3.75 |
| 25 | 5.55 | 4.45 | 3.50 | 3.60 | 3.55 | 3.70 |
| 26 | 5.68 | 4.38 | 3.48 | 3.60 | 3.55 | 3.70 |
| 27 | 5.72 | 4.20 | 3.50 | 3.60 | 3.55 | 3.70 |
| 28 | 5.52 | 4.10 | 3.50 | 3.60 | 3.55 | 3.75 |
| 29 | 5.45 | 4.00 | 3.48 | 3.60 | 3.60 | 3.60 |
| 30 | 5.35 | 3.90 | 3.45 | 3.65 | 3.65 | 3.60 |
| 31 | 5.35 | ..... | 3.45 | 3.62 | ..... | 3.60 |

*Rating table for Big Grizzly Creek at Hebron, Colo., from May 13 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.40 | 3 | 4.10 | 43 | 4.80 | 127 | 5.50 | 264 |
| 3.50 | 7 | 4.20 | 52 | 4.90 | 143 | 5.60 | 288 |
| 3.60 | 11 | 4.30 | 62 | 5.00 | 160 | 5.70 | 313 |
| 3.70 | 16 | 4.40 | 73 | 5.10 | 178 | 5.80 | 339 |
| 3.80 | 22 | 4.50 | 85 | 5.20 | 198 | 5.90 | 366 |
| 3.90 | 28 | 4.60 | 98 | 5.30 | 219 | 6.00 | 394 |
| 4.00 | 35 | 4.70 | 112 | 5.40 | 241 | | |

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is well defined to gage height 5.6 feet. The table has been extended above this limit.

*Estimated monthly discharge of Big Grizzly Creek at Hebron, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 13–31 | 318 | 115 | 207 | 7,801 |
| June | 380 | 28 | 152 | 9,045 |
| July | 29 | 5 | 12.0 | 738 |
| August | 35 | 3 | 14.1 | 867 |
| September | 13 | 3 | 8.73 | 519 |
| October | 19 | 8 | 13.7 | 842 |
| The period | | | | 19,820 |

## LITTLE GRIZZLY CREEK NEAR HEBRON, COLO.

This station was established June 3, 1904, by William A. Lamb. It is located at the wagon bridge on James Hill's ranch, one-half mile southwest of Hebron, Colo., and one-fourth mile west of the road from Hebron to Spicer. A plain staff gage is nailed vertically to the northwest corner of the center pier of the bridge. It is read twice each day by John Peterson. At low water measurements are made by wading 300 feet above the gage. At high water measurements are made from the downstream side of the 2-span bridge to which the gage is attached. The initial point for soundings is the east edge of the pier at the left bank. Points for sounding are marked every 2 feet by 10-penny nails driven into the guard rail on the downstream side of the bridge. The channel is straight for about 150 feet above and below the station, and the current has a medium and uniform

velocity. Both banks are low, and liable to overflow. The right bank is partly covered by willows. The bed of the stream is composed of gravel and is firm. There is but one channel at all stages, broken by the middle pier of the bridge. Bench mark No. 1 is a nail driven into the north end of the second log in the left abutment. Its elevation is 5.90 feet above the zero of the gage. Bench mark No. 2 is a nail driven into the north end of a log in the right abutment. Its elevation is 6.373 feet above the zero of the gage. Bench mark No. 3 is the top of a regulation iron bench-mark post, 80 feet east of the gage rod and 20 feet north of the road. Its elevation is 6.786 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Little Grizzly Creek near Hebron, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 3 | W. A. Lamb | 47 | 117 | 2.53 | 4.85 | 296 |
| June 13 | do | 47 | 159 | 3.45 | 5.60 | 548 |
| June 27 | do | 46 | 98 | 1.91 | 4.22 | 187 |
| July 12 | do | 28 | 17 | 2.18 | 3.05 | 37 |
| August 8 | do | 10 | 11 | 1.09 | 2.80 | 12 |
| September 12 [a] | do | 15 | 6 | 1.33 | 2.73 | 8 |

[a] Wading 300 feet above station.

*Mean daily gage height, in feet, of Little Grizzly Creek near Hebron, Colo., for 1904.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 4.00 | 2.90 | 2.90 | 2.80 | 17 | 4.95 | 2.92 | 3.00 | 2.70 | 2.80 |
| 2 | ..... | 3.85 | 2.90 | 2.90 | 2.85 | 18 | 4.65 | 2.95 | 3.00 | 2.70 | 2.80 |
| 3 | 4.82 | 3.78 | 2.80 | 2.80 | 2.80 | 19 | 4.72 | 2.90 | 2.85 | 2.70 | 2.80 |
| 4 | 4.52 | 3.85 | 2.80 | 2.80 | 2.89 | 20 | 4.68 | 2.90 | 2.90 | 2.70 | 2.88 |
| 5 | 4.05 | 3.72 | 2.80 | 2.82 | 2.85 | 21 | 4.78 | 2.80 | 2.90 | 2.70 | 2.85 |
| 6 | 3.92 | 3.62 | 2.80 | 2.85 | 2.85 | 22 | 4.80 | 2.90 | 2.85 | 2.75 | 2.90 |
| 7 | 4.25 | 3.50 | 2.80 | 2.85 | 2.80 | 23 | 4.48 | 2.90 | 2.85 | 2.75 | 2.92 |
| 8 | 4.45 | 3.40 | 2.80 | 2.85 | 2.80 | 24 | 4.62 | 2.90 | 2.90 | 2.75 | 2.95 |
| 9 | 4.88 | 3.30 | 2.80 | 2.80 | 2.80 | 25 | 4.30 | 2.90 | 2.90 | 2.75 | 2.90 |
| 10 | 4.78 | 3.20 | 2.80 | 2.80 | 2.80 | 26 | 4.22 | 2.85 | 2.90 | 2.75 | 2.85 |
| 11 | 4.90 | 3.25 | 2.85 | 2.80 | 2.78 | 27 | 4.20 | 2.90 | 2.85 | 2.75 | 2.80 |
| 12 | 5.35 | 3.05 | 2.90 | 2.75 | 2.75 | 28 | 4.10 | 2.90 | 2.85 | 2.75 | 2.85 |
| 13 | 5.40 | 3.00 | 2.90 | 2.75 | 2.80 | 29 | 3.95 | 2.90 | 2.85 | 2.80 | 2.80 |
| 14 | 5.45 | 3.00 | 2.90 | 2.70 | 2.80 | 30 | 4.02 | 2.95 | 2.82 | 2.80 | 2.80 |
| 15 | 5.15 | 3.00 | 2.85 | 2.70 | 2.80 | 31 | ..... | 2.95 | 2.92 | ..... | 2.82 |
| 16 | 5.15 | 3.00 | 2.95 | 2.70 | 2.85 | | | | | | |

*Rating table for Little Grizzly Creek near Hebron, Colo., from June 3 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.70 | 7 | 3.30 | 61 | 4.10 | 162 | 4.90 | 322 |
| 2.75 | 9 | 3.40 | 71 | 4.20 | 180 | 5.00 | 347 |
| 2.80 | 12 | 3.50 | 82 | 4.30 | 198 | 5.10 | 375 |
| 2.85 | 16 | 3.60 | 94 | 4.40 | 216 | 5.20 | 405 |
| 2.90 | 21 | 3.70 | 106 | 4.50 | 235 | 5.30 | 438 |
| 2.95 | 26 | 3.80 | 119 | 4.60 | 255 | 5.40 | 472 |
| 3.00 | 31 | 3.90 | 133 | 4.70 | 276 | 5.50 | 509 |
| 3.10 | 41 | 4.00 | 147 | 4.80 | 298 | 5.60 | 548 |
| 3.20 | 51 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly well defined.

*Estimated monthly discharge of Little Grizzly Creek near Hebron, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| June 3–30 | 490 | 136 | 27.2 | 15,110 |
| July | 147 | 12 | 49.0 | 3,013 |
| August | 31 | 12 | 18.0 | 1,107 |
| September | 21 | 7 | 10.8 | 643 |
| October | 26 | 9 | 14.5 | 892 |
| The period | | | | 20,760 |

## ROARING FORK RIVER NEAR HEBRON, COLO.

This station was established May 14, 1904, by M. C. Hinderlider. It is located at the highway bridge, about 2 miles above J. E. Mallon's ranch house and 4 miles northwest of Hebron, Colo., and is one-half mile above the mouth of the river. A standard chain gage was placed June 14, 1904, by William A. Lamb. It is located on the east side of the bridge, 18 feet from the south face of the north abutment. The length of the chain from the end of the weight to the marker is 7.70 feet. The gage is read three times each week by Walter Johnson. Discharge measurements are made at low stages by wading near the gage. At higher stages they are made from the single-span bridge to which the gage is attached, sounding points being marked on the downstream side with figures cut in the floor. The initial point for soundings is the south face of the north abutment, marked with a spike driven into the bridge floor. The channel is straight for about

100 feet above and 50 feet below the station, and the current is uniform and moderately swift. Both banks are about 5 feet high above and 3 feet high below the bridge, lined with willows, and not liable to overflow except at extremely high stages. The bed of the stream is composed of coarse gravel and cobblestones, uniform and stable. There is but one channel at all stages. Bench mark No. 1 is the top of a spike driven horizontally into the east end of the second timber from the top of the north abutment. The head of a nail driven vertically into the north end of the gage rod is 2.55 feet above this bench mark. The elevation of the bench mark is 2.86 feet above gage datum. Bench mark No. 2, established October 2, 1904, is the top of a cast-iron rod, 16 inches long by 1 inch at the lower end, tapering to a point at the upper end. It is set on a bowlder sunken in the ground by the side of the lane fence, 50 feet northeast of the north pier of the bridge. Its elevation is 7.14 feet above the gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Roaring Fork River near Hebron, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| 1904. | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 14 | W. A. Lamb | 36 | 31 | 2.65 | | 82 |
| May 27 | do | 42 | 90 | 3.64 | 3.49 | 328 |
| June 4 | do | 41 | 65 | 3.42 | 3.04 | 222 |
| July 13 | do | 34 | 37 | 2.95 | 2.00 | 109 |
| August 9 | do | 25 | 23 | 1.69 | 1.60 | 39 |
| September 13[a] | do | 18 | 15 | 1.00 | 1.32 | 15 |

[a] Measured at different section.

*Mean daily gage height, in feet, of Roaring Fork River near Hebron, Colo., for 1904.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Day. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.60 | 1.15 | 1.30 | | 17 | | 1.15 | 1.30 | 1.35 | |
| 2 | | | | | 1.30 | 18 | | | | | |
| 3 | | 1.75 | 1.65 | 1.30 | | 19 | | | 1.30 | | |
| 4 | | | | | | 20 | 2.03 | 1.20 | | 1.30 | |
| 5 | | | 1.20 | | 1.30 | 21 | | | 1.25 | | |
| 6 | | 1.65 | | 1.30 | | 22 | | 1.20 | 1.30 | 1.30 | |
| 7 | | | | | | 23 | 2.01 | | | | |
| 8 | | 1.75 | 1.20 | 1.30 | | 24 | | | 1.30 | 1.30 | |
| 9 | | | | | | 25 | 2.00 | 1.25 | | | |
| 10 | | 1.55 | 1.25 | 1.30 | | 26 | | | 1.30 | 1.25 | |
| 11 | | | | | | 27 | | 1.20 | | | |
| 12 | | | 1.25 | 1.30 | | 28 | 1.95 | | | | |
| 13 | | 1.25 | | 1.30 | | 29 | | 1.15 | 1.30 | 1.30 | |
| 14 | | | | | | 30 | 1.80 | | | | |
| 15 | | 1.02 | 1.30 | 1.40 | | 31 | | | | 1.30 | |
| 16 | | | | | | | | | | | |

*Rating table for Roaring Fork River near Hebron, Colo., from May 14 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 2 | 1.30 | 13 | 1.60 | 40 | 1.90 | 72 |
| 1.05 | 3 | 1.35 | 17 | 1.65 | 45 | 1.95 | 78 |
| 1.10 | 4 | 1.40 | 21 | 1.70 | 50 | 2.00 | 84 |
| 1.15 | 5 | 1.45 | 25 | 1.75 | 55 | 2.10 | 96 |
| 1.20 | 7 | 1.50 | 30 | 1.80 | 60 | | |
| 1.25 | 10 | 1.55 | 35 | 1.85 | 66 | | |

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is not well defined.

*Estimated monthly discharge of Roaring Fork River near Hebron, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| July, 5 days | 88 | 60 | 79.0 | [a] 1,880 |
| August, 13 days | 55 | 2 | 21.8 | [b] 1,340 |
| September, 14 days | 13 | 5 | 10.4 | [b] 619 |
| October, 15 days | 21 | 10 | 13.6 | [b] 836 |

[a] Acre-feet computed July 20-31. [b] Acre-feet computed for full month.

## MICHIGAN CREEK NEAR WALDEN, COLO.

This station was established May 9, 1904, by M. C. Hinderlider. It is located at the highway bridge, one-half mile east of Walden, Colo. A plain, vertical, staff gage is attached to the left downstream corner of the middle pier. The gage is graduated to feet and tenths from 4 to 10 feet, the 4-foot mark resting on the bed of the stream at the foot of the pier. It is read twice each day by J. K. P. McCallum. Discharge measurements are made at ordinary stages by wading a short distance above the two-span bridge to which the gage is attached. At high stages they are made from the downstream side of the bridge. The initial point for soundings is a 30-penny nail driven into the floor at the west end of the bridge. The channel is straight for about 75 feet above and 50 feet below the station. The current is medium at low and swift at high stages. Both banks are about three feet high, bordered by flat meadow lands, and are not liable to overflow. The bed of the stream is composed of sand and gravel, free from vegetation, and is fairly permanent. Bench mark No. 1 is the top of a nail driven into the left abutment of the bridge on the downstream side. Its elevation is 7.910 feet above the gage datum. Bench mark No. 2 is the top of a 20-penny nail driven into the top of a sandstone bowlder

under the cliff on the north side of the river, about 275 feet northeast of the east end of the bridge. It is marked "B. M. U. S. G. S." Its elevation is 15.335 feet above the gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Michigan Creek near Walden, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 8[a] | W. A. Lamb | 40 | 37 | 3.32 | 4.95 | 123 |
| May 24 | do | 72 | 79 | 3.29 | 5.41 | 260 |
| June 1 | do | 40 | 90 | 3.07 | 5.51 | 276 |
| July 9 | do | 56 | 85 | 2.33 | 5.28 | 198 |
| August 6 | do | 28 | 23 | 2.17 | 4.70 | 50 |
| August 22 | do | 29 | 28 | 2.64 | 4.77 | 74 |
| September 6[a] | do | 26 | 18 | 2.00 | 4.60 | 36 |
| October 28[a] | do | 25 | 15 | 2.20 | 4.60 | 33 |

[a] Wading at different section.

*Mean daily gage height, in feet, of Michigan Creek near Walden, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 5.48 | 5.50 | 4.80 | 4.70 | 4.55 |
| 2 | ..... | 5.45 | 5.42 | 4.78 | 4.88 | 4.50 |
| 3 | ..... | 5.60 | 5.40 | 4.75 | 4.75 | 4.50 |
| 4 | ..... | 5.62 | 5.35 | 4.70 | 4.70 | 4.50 |
| 5 | ..... | 5.45 | 5.32 | 4.70 | 4.68 | 4.50 |
| 6 | ..... | 5.38 | 5.25 | 4.70 | 4.68 | 4.50 |
| 7 | ..... | 5.38 | 5.28 | 4.70 | 4.60 | 4.52 |
| 8 | ..... | 5.45 | 5.28 | 4.70 | 4.60 | 4.55 |
| 9 | 4.88 | 5.58 | 5.28 | 4.65 | 4.60 | 4.55 |
| 10 | 4.95 | 5.60 | 5.12 | 4.65 | 4.60 | 4.55 |
| 11 | 5.22 | 5.65 | 5.10 | 4.70 | 4.55 | 4.60 |
| 12 | 5.05 | 5.62 | 5.10 | 4.78 | 4.55 | 4.55 |
| 13 | 4.75 | 5.68 | 5.05 | 4.72 | 4.55 | 4.60 |
| 14 | 5.00 | 5.78 | 5.05 | 4.70 | 4.50 | 4.58 |
| 15 | 5.00 | 5.88 | 5.02 | 4.70 | 4.50 | 4.55 |
| 16 | 5.02 | 5.90 | 4.98 | 4.75 | 4.50 | 4.55 |
| 17 | 4.95 | 5.85 | 4.75 | 4.85 | 4.50 | 4.55 |
| 18 | 4.90 | 5.80 | 4.98 | 4.80 | 4.50 | 4.55 |
| 19 | 4.98 | 5.70 | 4.90 | 4.82 | 4.50 | 4.55 |
| 20 | 5.15 | 5.68 | 4.90 | 4.78 | 4.50 | 4.60 |
| 21 | 5.20 | 5.68 | 4.90 | 4.75 | 4.50 | 4.60 |
| 22 | 5.20 | 5.72 | 4.90 | 4.78 | 4.50 | 4.60 |
| 23 | 5.30 | 5.68 | 4.90 | 4.70 | 4.60 | 4.60 |
| 24 | 5.30 | 5.68 | 4.90 | 4.68 | 4.52 | 4.60 |
| 25 | 5.50 | 5.62 | 4.90 | 4.62 | 4.50 | 4.60 |
| 26 | 5.60 | 5.50 | 4.82 | 4.60 | 4.52 | 4.60 |
| 27 | 5.62 | 5.48 | 4.80 | 4.68 | 4.58 | 4.65 |
| 28 | 5.45 | 5.35 | 4.82 | 4.70 | 4.55 | 4.60 |
| 29 | 5.35 | 5.35 | 4.90 | 4.70 | 4.55 | 4.60 |
| 30 | 5.42 | 5.38 | 4.92 | 4.70 | 4.60 | 4.60 |
| 31 | 5.40 | ..... | 4.82 | 4.65 | ..... | 4.60 |

*Rating table for Michigan Creek near Walden, Colo., from May 8 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.50 | 17 | 4.75 | 60 | 5.00 | 118 | 5.50 | 280 |
| 4.55 | 24 | 4.80 | 71 | 5.10 | 145 | 5.60 | 321 |
| 4.60 | 32 | 4.85 | 82 | 5.20 | 174 | 5.70 | 364 |
| 4.65 | 41 | 4.90 | 94 | 5.30 | 207 | 5.80 | 411 |
| 4.70 | 50 | 4.95 | 106 | 5.40 | 242 | 5.90 | 460 |

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 4.6 feet and 5.5 feet.

*Estimated monthly discharge of Michigan Creek near Walden, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Mimimum. | Mean. | |
| May 9–31 | 329 | 60 | 177 | 8,073 |
| June | 460 | 224 | 320 | 19,040 |
| July | 280 | 60 | 137 | 8,424 |
| August | 82 | 32 | 54.3 | 3,339 |
| September | 89 | 17 | 29.7 | 1,767 |
| October | 41 | 17 | 26.8 | 1,648 |
| The period | | | | 42,290 |

## MICHIGAN CREEK, OR MIDDLE FORK RIVER, NEAR COWDREY, COLO.

This station was established May 9, 1904, by M. C. Hinderlider. It is located 100 feet above the wagon bridge, 1½ miles northwest of Cowdrey, Colo. The gage is an inclined staff, graduated vertically to feet and tenths, spiked firmly to posts set into the left bank. The distance between the footmarks on the slope is 1.6 feet. The gage is read twice each day by L. L. Knoles. Discharge measurements are made at all ordinary stages by wading near the gage. At extreme high-water measurements are made from the wagon bridge 100 feet below the gage rod. The initial point for soundings is the top of the left bank at the gage. The channel is straight for about 50 feet above and 100 feet below the station, and the current is medium. The right bank is a gradually sloping gravel bar and overflows at high water for about 80 feet. The left bank is about 2.5 feet high, sodded, and does not overflow. The bed of the stream is composed of gravel, free from vegetation, uniform, and permanent. Bench mark No. 1 is a 30-penny

nail driven into the top of the south end of the cap timber of the first pile bent at the east end of the bridge. A witness nail is driven beside it. The elevation of the bench mark is 6.23 feet above the zero of the gage. Bench mark No. 2 is the top of an iron post located 3 feet south of the fence on the south side of the road, 75 feet north of the gage rod and 50 feet west of the river bank. Its elevation is 6.255 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Michigan Creek, or Middle Fork River, near Cowdrey, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 7 | W. A. Lamb | 54 | 97 | 2.71 | 3.30 | 264 |
| June 10 | do | 53 | 157 | 2.41 | 3.55 | 379 |
| June 17 | do | 56 | 177 | 2.58 | 4.02 | 456 |
| June 29[a] | do | 42 | 69 | 3.06 | 3.05 | 211 |
| August 3 | do | 36 | 33 | 2.24 | 2.30 | 74 |
| August 22 | do | 38 | 41 | 2.22 | 2.44 | 91 |
| September 6[a] | do | 39 | 34 | 1.47 | 2.20 | 50 |
| September 24[a] | do | 28 | 17 | 1.76 | 2.00 | 30 |

[a] Wading at different section.

*Mean daily gage height, in feet, of Michigan Creek, or Middle Fork River, near Cowdrey, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 3.32 | 3.20 | 2.38 | 2.30 | 2.00 |
| 2 | ..... | 3.30 | 3.28 | 2.35 | 2.36 | 2.00 |
| 3 | ..... | 3.65 | 3.20 | 2.32 | 2.42 | 2.00 |
| 4 | ..... | 4.02 | 3.20 | 2.25 | 2.30 | 1.95 |
| 5 | ..... | 3.80 | 3.10 | 2.22 | 2.22 | 1.90 |
| 6 | ..... | 3.40 | 3.20 | 2.22 | 2.20 | 1.90 |
| 7 | ..... | 3.20 | 3.40 | 2.20 | 2.12 | 1.90 |
| 8 | ..... | 3.30 | 3.30 | 2.20 | 2.05 | 1.90 |
| 9 | ..... | 3.45 | 3.12 | 2.15 | 2.00 | 2.00 |
| 10 | ..... | 3.52 | 2.98 | 2.12 | 2.00 | 2.00 |
| 11 | ..... | 3.48 | 2.92 | 2.15 | 2.00 | 2.00 |
| 12 | 2.35 | 3.52 | 2.80 | 2.20 | 2.00 | 2.00 |
| 13 | 2.30 | 3.52 | 2.80 | 2.25 | 2.00 | 2.00 |
| 14 | 2.28 | 3.62 | 2.75 | 2.25 | 2.00 | 2.00 |
| 15 | 2.20 | 3.78 | 2.58 | 2.20 | 1.95 | 2.00 |
| 16 | 2.22 | 3.98 | 2.50 | 2.20 | 1.90 | 2.00 |
| 17 | 2.20 | 4.05 | 2.50 | 2.45 | 1.90 | 2.05 |
| 18 | 2.12 | 3.90 | 2.40 | 2.50 | 1.90 | 2.00 |
| 19 | 2.10 | 3.80 | 2.38 | 2.50 | 1.88 | 2.00 |
| 20 | 2.18 | 3.70 | 2.35 | 2.50 | 1.90 | 2.00 |
| 21 | 2.35 | 3.70 | 2.35 | 2.40 | 1.95 | 2.00 |
| 22 | 3.05 | 3.60 | 2.38 | 2.40 | 1.95 | 2.00 |
| 23 | 2.68 | 3.60 | 2.32 | 2.38 | 2.00 | 2.00 |
| 24 | 2.90 | 3.65 | 2.38 | 2.38 | 2.00 | 2.00 |
| 25 | 3.22 | 3.65 | 2.40 | 2.28 | 1.98 | 2.00 |
| 26 | 3.65 | 3.15 | 2.40 | 2.10 | 1.95 | 2.00 |
| 27 | 3.80 | 3.20 | 2.32 | 2.12 | 2.00 | 2.00 |
| 28 | 3.55 | 3.05 | 2.35 | 2.20 | 2.00 | 2.00 |
| 29 | 3.28 | 3.00 | 2.40 | 2.22 | 2.00 | 2.00 |
| 30 | 3.18 | 3.00 | 2.45 | 2.25 | 2.00 | 2.00 |
| 31 | 3.18 | ..... | 2.45 | 2.28 | ..... | 2.00 |

*Rating table for Michigan Creek, or Middle Fork River, near Cowdrey, Colo., from May 12 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.90 | 19 | 2.40 | 86 | 3.00 | 200 | 3.60 | 353 |
| 1.95 | 24 | 2.50 | 103 | 3.10 | 221 | 3.70 | 384 |
| 2.00 | 29 | 2.60 | 121 | 3.20 | 245 | 3.80 | 417 |
| 2.10 | 42 | 2.70 | 140 | 3.30 | 270 | 3.90 | 451 |
| 2.20 | 56 | 2.80 | 160 | 3.40 | 296 | 4.00 | 489 |
| 2.30 | 70 | 2.90 | 180 | 3.50 | 323 | 4.10 | 530 |

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 2 feet and 3.5 feet.

*Estimated monthly discharge of Michigan Creek, or Middle Fork River, near Cowdrey, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 12–31 | 417 | 42 | 162 | 6,427 |
| June | 509 | 200 | 342 | 20,350 |
| July | 296 | 73 | 148 | 9,100 |
| August | 103 | 42 | 67.9 | 4,175 |
| September | 89 | 17 | 35.6 | 2,118 |
| October | 35 | 19 | 27.7 | 1,703 |
| The period | | | | 43,870 |

## CANADIAN CREEK NEAR COWDREY, COLO.

This station was established May 10, 1904, by M. C. Hinderlider. It is located at the highway bridge one-half mile east of Cowdrey, Colo. A plain, vertical, staff gage is attached to the west face of the first pile from the left bank on the downstream side of the bridge. The gage is graduated to feet and tenths from 2 feet to 8 feet, the 2-foot mark resting on the bed of the stream. It is read twice each day by L. L. Knoles. Discharge measurements are made at all normal stages by wading a short distance above the bridge to which the gage is attached. At exceedingly high stages measurements are made from the bridge, which is marked every 2 feet on the downstream guard rail. The initial point for soundings is a 20-penny nail driven into the floor of the bridge over the face of the left abutment on the downstream side. The channel is straight for about 150 feet above and 40 feet below the station, and the current is uniform and of medium velocity. Both banks are about 2 feet high, bordered with willows and bushes above the bridge, and clean below. The left bank overflows at extreme high stages of the stream. The bed of the stream is composed of sand and silt, with a few stones from the riprap at the west end of the bridge, and is shifting. There is but one channel at all stages, broken by four pile bents. Bench mark No. 1 is a 30-penny spike nail driven flush with the top of the cap timber above the gage rod. Its elevation is 9.80 feet above the gage datum. Bench mark No. 2 is a 30-penny nail driven horizontally into the north face of a telephone pole, 3 feet above the ground, 60 feet south of the left end of the bridge. Its elevation is 9.80 feet above the datum of the gage. Bench mark No. 3 is a regulation iron bench-mark post, 3 feet south of the fence on the north side of the road, 40 feet west of the gage rod. Its elevation is 8.02 feet above gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Canadian Creek near Cowdrey, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 10[a] | W. A. Lamb | 21 | 38 | 1.74 | 4.68 | 66 |
| May 24 | do | 37 | 58 | 1.87 | 5.18 | 105 |
| May 31 | do | 57 | 68 | 1.72 | 5.15 | 117 |
| June 7 | do | 54 | 79 | 2.15 | 5.20 | 170 |
| June 11 | do | 54 | 89 | 2.75 | 5.45 | 244 |
| June 30[a] | do | 23 | 33 | 2.03 | 4.73 | 67 |
| July 8 | do | 33 | 52 | 2.00 | 5.00 | 104 |
| August 4 | do | 28 | 19 | 1.42 | 4.30 | 27 |
| August 22 | do | 23 | 22 | 1.59 | 4.42 | 35 |
| September 5 | do | 27 | 17 | 1.06 | 4.22 | 18 |

[a] Wading at different section.

*Mean daily gage height, in feet, of Canadian Creek near Cowdrey, Colo., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 5.20 | 4.85 | 4.42 | 4.30 | 4.25 |
| 2 | ..... | 5.15 | 5.10 | 4.40 | 4.30 | 4.20 |
| 3 | ..... | 5.40 | 4.95 | 4.32 | 4.40 | 4.20 |
| 4 | ..... | 5.90 | 4.95 | 4.30 | 4.32 | 4.20 |
| 5 | ..... | 5.45 | 4.92 | 4.30 | 4.25 | 4.20 |
| 6 | ..... | 5.22 | 4.80 | 4.28 | 4.20 | 4.20 |
| 7 | ..... | 5.15 | 4.98 | 4.25 | 4.20 | 4.15 |
| 8 | ..... | 5.25 | 4.98 | 4.28 | 4.20 | 4.10 |
| 9 | ..... | 5.55 | 4.90 | 4.20 | 4.20 | 4.10 |
| 10 | ..... | 5.45 | 4.68 | 4.20 | 4.20 | 4.10 |
| 11 | ..... | 5.40 | 4.62 | 4.15 | 4.20 | 4.10 |
| 12 | 4.68 | 5.45 | 4.55 | 4.20 | 4.15 | 4.10 |
| 13 | 4.70 | 5.38 | 4.50 | 4.20 | 4.10 | 4.10 |
| 14 | 4.70 | 5.38 | 4.52 | 4.15 | 4.10 | 4.10 |
| 15 | 4.70 | 5.42 | 4.62 | 4.25 | 4.10 | 4.10 |
| 16 | 4.70 | 5.45 | 4.55 | 4.30 | 4.10 | 4.10 |
| 17 | 4.72 | 5.40 | 4.60 | 4.40 | 4.10 | 4.20 |
| 18 | 4.58 | 5.38 | 4.78 | 4.50 | 4.10 | 4.20 |
| 19 | 4.55 | 5.42 | 4.50 | 4.50 | 4.15 | 4.20 |
| 20 | 4.62 | 5.25 | 4.48 | 4.50 | 4.12 | 4.20 |
| 21 | 5.00 | 5.28 | 4.50 | 4.40 | 4.10 | 4.20 |
| 22 | 5.08 | 5.15 | 4.50 | 4.40 | 4.20 | 4.20 |
| 23 | 5.05 | 5.10 | 4.48 | 4.32 | 4.20 | 4.20 |
| 24 | 5.15 | 5.10 | 4.48 | 4.30 | 4.20 | 4.20 |
| 25 | 5.32 | 5.10 | 4.55 | 4.28 | 4.20 | 4.20 |
| 26 | 5.45 | 5.00 | 4.52 | 4.22 | 4.20 | 4.20 |
| 27 | 5.48 | 4.88 | 4.50 | 4.28 | 4.28 | 4.20 |
| 28 | 5.30 | 4.78 | 4.52 | 4.25 | 4.30 | 4.20 |
| 29 | 5.10 | 4.72 | 4.58 | 4.22 | 4.30 | 4.20 |
| 30 | 5.02 | 4.70 | 4.58 | 4.28 | 4.25 | 4.20 |
| 31 | 5.10 | ..... | 4.58 | 4.30 | ..... | 4.20 |

*Rating table for Canadian Creek near Cowdrey, Colo., from May 10 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.10 | 10 | 4.40 | 33 | 4.70 | 66 | 5.00 | 110 |
| 4.15 | 13 | 4.45 | 38 | 4.75 | 72 | 5.10 | 131 |
| 4.20 | 17 | 4.50 | 43 | 4.80 | 78 | 5.20 | 157 |
| 4.25 | 21 | 4.55 | 48 | 4.85 | 85 | 5.30 | 188 |
| 4.30 | 25 | 4.60 | 54 | 4.90 | 93 | 5.40 | 223 |
| 4.35 | 29 | 4.65 | 60 | 4.95 | 101 | 5.50 | 265 |

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904. It is well defined between gage heights 4.2 feet and 5 feet. The table has been extended beyond these limits.

*Estimated monthly discharge of Canadian Creek near Cowdrey, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 12–31 | 256 | 48 | 116 | 4,602 |
| June | 288 | 66 | 189 | 11,250 |
| July | 131 | 41 | 63.7 | 3,917 |
| August | 43 | 13 | 25.3 | 1,556 |
| September | 33 | 10 | 17.3 | 1,029 |
| October | 21 | 10 | 15.0 | 922 |
| The period | | | | 23,280 |

## LARAMIE RIVER NEAR GLENDEVEY, COLO.

This station was established June 24, 1904, by William A. Lamb. It is located at the highway bridge one-eighth mile west of Glendevey, Colo., on the State road between Walden and Fort Collins. A plain staff gage is attached to the northwest corner of the first pier from the right bank. It is read twice each day by W. W. Summers. Discharge measurements are made from the downstream side of the three-span bridge to which the gage is attached. Points for soundings are marked by numbers painted at intervals of 2 feet on the floor of the bridge. The initial point for soundings is a 30-penny nail driven into the guard log directly over the east face of the wooden pier at the left end of the bridge. The channel is straight for about 200 feet above and 300 feet below the station, and the current is swift at all stages. Both banks are high, wooded, and not liable to overflow. The bed of the stream is covered with bowlders and coarse gravel, free from vegeta-

tion, and permanent. There is one channel at all stages, broken by three piers. Bench mark No. 1 is a cross cut in the top of a granite bowlder, 18 inches in diameter, located 10 feet northwest of the initial point for soundings. Its elevation is 7.325 feet above the zero of the gage. Bench mark No. 2 is a cross cut in the top of a granite bowlder, 3 feet in diameter, located 75 feet northwest of the initial point for soundings. Its elevation is 16.841 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Laramie River near Glenderey, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 24 [a] | W. A. Lamb | 54 | 86 | 4.83 | 3.00 | 415 |
| July 5 [a] | do | 61 | 67 | 3.66 | 2.60 | 245 |
| August 2 [a] | do | 32 | 36 | 2.53 | 2.15 | 91 |
| August 20 | do | 35 | 34 | 1.94 | 2.08 | 66 |
| September 4 | do | 32 | 30 | 1.80 | 2.00 | 54 |
| October 24 | do | 25 | 22 | 1.45 | 1.85 | 32 |

[a] Measurements June 24, July 5, and Aug. 2 are probably several per cent too large on account of defective meter.

*Mean daily gage height, in feet, of Laramie River near Glenderey, Colo., for 1904.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 3.00 | 2.12 | 2.00 | 2.00 | 17 | | 2.30 | 2.10 | 1.90 | 2.00 |
| 2 | | 2.68 | 2.10 | 2.00 | 2.00 | 18 | | 2.28 | 2.15 | 1.90 | 2.00 |
| 3 | | 2.62 | 2.10 | 2.00 | 2.00 | 19 | | 2.25 | 2.08 | 1.90 | 2.00 |
| 4 | | 2.62 | 2.10 | 2.00 | 1.90 | 20 | | 2.22 | 2.05 | 1.90 | 1.90 |
| 5 | | 2.60 | 2.10 | 2.00 | 1.90 | 21 | | 2.22 | 2.05 | 1.90 | 1.90 |
| 6 | | 2.60 | 2.05 | 2.00 | 1.90 | 22 | | 2.22 | 2.05 | 1.90 | 1.90 |
| 7 | | 2.60 | 2.05 | 1.98 | 1.90 | 23 | | 2.20 | 2.00 | 1.90 | 1.90 |
| 8 | | 2.70 | 2.05 | 1.92 | 1.90 | 24 | 3.00 | 2.20 | 2.00 | 1.90 | 1.90 |
| 9 | | 2.52 | 2.08 | 1.90 | 1.90 | 25 | 2.75 | 2.20 | 2.00 | 1.90 | 1.90 |
| 10 | | 2.38 | 2.05 | 1.90 | 1.90 | 26 | 2.72 | 2.20 | 2.00 | 1.90 | 1.85 |
| 11 | | 2.42 | 2.00 | 1.90 | 1.90 | 27 | 2.72 | 2.18 | 2.00 | 1.90 | 1.80 |
| 12 | | 2.40 | 2.10 | 1.90 | 1.90 | 28 | 2.65 | 2.20 | 2.00 | 1.90 | 1.80 |
| 13 | | 2.38 | 2.08 | 1.90 | 1.90 | 29 | 2.65 | 2.20 | 2.00 | 1.90 | 1.80 |
| 14 | | 2.30 | 2.05 | 1.90 | 1.90 | 30 | 2.65 | 2.15 | 2.00 | 2.00 | 1.80 |
| 15 | | 2.30 | 2.05 | 1.90 | 1.90 | 31 | | 2.15 | 2.00 | | 1.80 |
| 16 | | 2.30 | 2.10 | 1.90 | 1.90 | | | | | | |

## LARAMIE RIVER NEAR JELM, WYO.

This station was established June 22, 1904, by W. A. Lamb. It is located at the wagon bridge at H. T. Decker's ranch, one-half mile south of the Colorodo-Wyoming State line, near Jelm, Wyo. A plain

staff gage, graduated to feet and tenths, is fastened in a vertical position to the northwest corner of the center pier of the bridge. The gage is read twice each day by H. T. Decker. Discharge measurements are made from the downstream side of the four-span bridge, to which the gage is attached. The initial point for soundings is a 30-penny nail driven into the left end of the downstream guard rail. The channel is straight for about 50 feet above and 300 feet below the station, and the current is swift. Both banks are high, covered with willows, and not subject to overflow. The bed of the stream is composed of gravel and bowlders, and is firm. There is but one channel at all stages, broken by the three piers of the bridge. The bench mark is a 30-penny nail driven into the lower log at the southwest corner of H. T. Decker's house. Its elevation is 12.35 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Laramie River near Jelm, Wyo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 22 [a] | W. A. Lamb | 60 | 146 | 5.37 | 4.30 | 784 |
| July 6 [a] | do | 52 | 112 | 4.33 | 3.40 | 492 |
| August 2 [a] | do | 44 | 63 | 2.22 | 2.30 | 140 |
| August 20 | do | 44 | 59 | 1.83 | 2.25 | 108 |
| October 27 | do | 44 | 37 | 1.33 | 2.00 | 49 |

[a] Measurements June 22, July 6, and Aug. 2 in error by several per cent owing to defective meter.

*Mean daily gage height, in feet, of Laramie River near Jelm, Wyo., for 1904.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 3.85 | 2.30 | 2.10 | 1.90 | 17 | | 2.50 | 2.40 | 1.90 | 2.00 |
| 2 | | 3.45 | 2.30 | 2.10 | 1.90 | 18 | | 2.50 | 2.45 | 1.90 | 2.00 |
| 3 | | 3.30 | 2.30 | 2.10 | 1.90 | 19 | | 2.45 | 2.35 | 1.90 | 2.00 |
| 4 | | 3.35 | 2.30 | 2.10 | 1.90 | 20 | | 2.40 | 2.30 | 1.90 | 2.00 |
| 5 | | 3.20 | 2.30 | 2.05 | 1.90 | 21 | | 2.35 | 2.30 | 1.90 | 2.00 |
| 6 | | 3.25 | 2.20 | 2.00 | 1.90 | 22 | 4.20 | 2.45 | 2.25 | 1.90 | 2.00 |
| 7 | | 3.20 | 2.20 | 2.00 | 1.90 | 23 | 4.10 | 2.40 | 2.20 | 1.90 | 2.00 |
| 8 | | 3.40 | 2.20 | 2.00 | 1.90 | 24 | 4.15 | 2.40 | 2.10 | 2.00 | 2.00 |
| 9 | | 3.05 | 2.20 | 2.00 | 2.00 | 25 | 3.82 | 2.50 | 2.10 | 2.00 | 2.00 |
| 10 | | 2.75 | 2.15 | 2.00 | 2.00 | 26 | 3.60 | 2.40 | 2.10 | 2.00 | 2.00 |
| 11 | | 2.75 | 2.10 | 1.90 | 2.00 | 27 | 3.60 | 2.40 | 2.10 | 2.00 | 2.00 |
| 12 | | 2.65 | 2.15 | 1.90 | 2.00 | 28 | 3.40 | 2.40 | 2.10 | 2.05 | 2.00 |
| 13 | | 2.55 | 2.10 | 2.00 | 2.00 | 29 | 3.25 | 2.40 | 2.10 | 2.00 | 2.00 |
| 14 | | 2.60 | 2.20 | 2.00 | 2.00 | 30 | 3.25 | 2.40 | 2.10 | 2.00 | 2.00 |
| 15 | | 2.50 | 2.20 | 1.90 | 2.00 | 31 | | 2.30 | 2.10 | | 2.00 |
| 16 | | 2.45 | 2.20 | 1.90 | 2.00 | | | | | | |

## M'INTYRE CREEK AT GLENEYRE, COLO.

This station was established June 23, 1904, by W. A. Lamb. It is located at the wagon bridge on Smith's ranch at Gleneyre, Colo. A plain staff gage is attached vertically to a post which is driven into the bed of the stream and fastened to the left end of the bridge. It is read twice each day by Elbert E. Smith. Discharge measurements are made from the upstream side of the bridge to which the gage is attached. The initial point for soundings is at the edge of the gage rod. The channel is straight for about 200 feet above and 30 feet below the station, and the current is swift at all stages. The right bank is low, partly covered with willows, and is liable to overflow. The left bank is high, covered with willows, and does not overflow. The bed of the stream is composed of gravel and small bowlders and is firm. The bench mark is the top of an iron rod three-fourths inch in diameter and 2½ feet long, with an L-shaped bend at the lower end, resting on a granite bowlder, 14 inches in diameter, which is set 2 feet under ground, 30 feet northeast of the gage. Its elevation is 5.308 feet above gage datum.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of McIntyre Creek at Gleneyre, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 23 | W. A. Lamb | 32 | 49 | 3.51 | 2.98 | 172 |
| July 6 | do | 28 | 32 | 2.81 | 2.38 | 90 |
| August 2 | do | 12 | 18 | 1.17 | 1.75 | 21 |
| August 20 | do | 12 | 17 | 1.06 | 1.76 | 18 |
| September 4 | do | 11 | 14 | .86 | 1.65 | 12 |
| October 26[a] | do | 11 | 14 | .79 | 1.60 | 11 |

[a] Wading 50 feet below station.

*Mean daily gage height, in feet, of McIntyre Creek at Gleneyre, Colo., for 1904.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 2.95 | 1.85 | 2.00 | 17 | ..... | 2.05 | 1.85 | 1.85 |
| 2 | ..... | 2.80 | 1.85 | 1.90 | 18 | ..... | 2.05 | 1.85 | 1.85 |
| 3 | ..... | 2.60 | 1.82 | 1.90 | 19 | ..... | 2.08 | 1.85 | 1.85 |
| 4 | ..... | 2.35 | 1.82 | 1.90 | 20 | ..... | 2.05 | 2.10 | 1.85 |
| 5 | ..... | 2.55 | 1.78 | 1.90 | 21 | ..... | 1.95 | 1.92 | 1.85 |
| 6 | ..... | 2.30 | 1.72 | 1.85 | 22 | ..... | 1.92 | 2.00 | 1.85 |
| 7 | ..... | 2.48 | 1.72 | 1.85 | 23 | ..... | 1.85 | 1.90 | 1.85 |
| 8 | ..... | 2.65 | 1.75 | 1.85 | 24 | 3.05 | 1.92 | 1.88 | 1.85 |
| 9 | ..... | 2.38 | 1.75 | 1.85 | 25 | 2.92 | 1.92 | 1.85 | 1.88 |
| 10 | ..... | 2.35 | 1.78 | 1.85 | 26 | 2.92 | 1.85 | 1.85 | 1.90 |
| 11 | ..... | 2.30 | 1.80 | 1.85 | 27 | 2.85 | 1.85 | 1.85 | 1.85 |
| 12 | ..... | 2.22 | 1.80 | 1.85 | 28 | 2.82 | 1.85 | 1.85 | 1.85 |
| 13 | ..... | 2.10 | 1.80 | 1.85 | 29 | 2.85 | 1.85 | 1.90 | 1.85 |
| 14 | ..... | 2.10 | 1.85 | 1.85 | 30 | 2.92 | 1.88 | 1.85 | 1.85 |
| 15 | ..... | 2.09 | 1.85 | 1.85 | 31 | ..... | 1.85 | 1.85 | ..... |
| 16 | ..... | 2.05 | 2.00 | 1.85 | | | | | |

*Rating table for McIntyre Creek at Gleneyre, Colo., from June 24 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.60 | 8 | 1.85 | 30 | 2.20 | 68 | 2.70 | 133 |
| 1.65 | 12 | 1.90 | 35 | 2.30 | 80 | 2.80 | 147 |
| 1.70 | 16 | 1.95 | 40 | 2.40 | 92 | 2.90 | 161 |
| 1.75 | 20 | 2.00 | 45 | 2.50 | 105 | 3.00 | 176 |
| 1.80 | 25 | 2.10 | 56 | 2.60 | 119 | 3.10 | 192 |

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is fairly well defined.

*Estimated monthly discharge of McIntyre Creek at Gleneyre, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| June 24–30 | 184 | 150 | 162 | 2,249 |
| July | 168 | 50 | 66.2 | 4,070 |
| August | 56 | 18 | 29.9 | 1,838 |
| September | 45 | 30 | 31.4 | 1,868 |

## SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station is located at the junction of the North and South forks of South Platte River, at the town of South Platte, located on the Colorado and Southern Railroad, about 9 miles above the mouth of

the canyon. The station was established March 28, 1902, by John E. Field, at the wagon bridge crossing the main stream about 150 feet below the junction of the two forks. This station is of special importance, its location being above the diverting gates of all irrigating ditches, and also above the intake of the Denver Union Water Company, which derives the greater part of its supply of water from South Platte River a few miles below this station. The location of the Cheesman storage reservoir on the South Fork, 20 miles above this station, and the contemplated installation of large power plants of the two forks above, also add to the importance of this station as a point from which to secure data. Bridges across either fork above the main station allow of measurements being made on these streams, thereby checking all gagings on the main stream below. This station is located only about 200 feet from the Colorado and Southern Railroad station and is easily accessible from Denver. The gage is a vertical 2 by 6 inch pine timber reading from zero to 7 feet and is fastened to the upper side of the center pier of the highway bridge. When the gage reads 2.3 feet or less, measurements are made by wading about 250 feet below the bridge. At high water discharge measurements are made from the lower side of the two-span highway bridge to which the gage is attached.

The gage is read twice each day by Mrs. Mata Wallbrecht, postmistress. The initial point for soundings is the river face of the right abutment. The channel is straight for 250 feet above and 400 feet below the station. The current is rough and rapid beneath the bridge, but becomes more even below. The right bank is the side of the mountain. The left bank, at ordinary stages, is part of the old river bed, about 100 feet wide. At extremely high water the Colorado and Southern Railroad roadbed is the left bank. At the bridge the river is divided into two channels by the center pier. The right channel is the deeper and carries most of the water. An old abutment foundation directly under the left end of the bridge interferes with the current during high stages. The bench mark is a nail driven horizontally in the right side of the upper end of a 12 by 12 inch cap timber on top of the middle pier of the bridge. It is inclosed in a circle of white paint and has four other nails driven about it. It is directly over the gage rod and has an elevation of 10.15 feet above the zero of the gage. Bench mark No. 2 is a regulation metal tablet in the cliff about 75 feet from the south end of the bridge. The elevation is 18.43 feet above zero of gage.

During the floods of 1904 both bridges on the North and South forks were carried away, which prevents high water measurements being made on either fork.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of South Platte River at South Platte, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 17 [a] | R. I. Meeker | 28 | 29 | 1.62 | 1.05 | 47 |
| March 28 [a] | O. McDermith | 30 | 34 | 1.79 | 1.15 | 61 |
| April 12 [a] | G. B. Monk | 52 | 58 | 3.09 | 1.70 | 179 |
| May 5 | T. E. Brick | 58 | 117 | 3.01 | 2.10 | 352 |
| May 26 [b] | M. C. Hinderlider | ..... | 161 | 3.50 | 2.90 | 563 |
| June 28 [c] | T. E. Brick | 42 | 122 | 6.58 | 3.20 | 803 |
| July 26 [d] | R. I. Meeker | 63 | 103 | 2.45 | 1.90 | 252 |
| July 29 [b] | T. Tobish | ..... | 143 | 3.57 | 2.85 | 510 |
| August 18 [d] | T. E. Brick | 56 | 177 | 6.18 | 4.35 | 1,094 |
| September 8 [c] | do | 54 | 94 | 3.52 | 2.10 | 331 |
| September 8 [d] | do | 76 | 134 | 2.56 | 2.10 | 343 |

[a] Wading one-fourth mile below station.
[b] North Fork and South Fork.
[c] From bridge at rod.
[d] Wading 300 feet below station.

*Mean daily gage height, in feet, of South Platte River at South Platte, Colo., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.62 | 2.55 | 1.28 | 1.12 | 1.75 | 2.55 | 2.55 | 2.90 | 3.25 | 2.05 | 1.32 | 1.05 |
| 2 | 1.80 | 2.62 | 1.28 | 1.20 | 2.00 | 2.60 | 2.45 | 2.90 | 2.92 | 1.98 | 1.20 | 1.00 |
| 3 | 2.00 | 2.40 | 1.12 | 1.20 | 2.25 | 3.55 | 2.60 | 2.85 | 2.95 | 1.78 | 1.08 | 1.05 |
| 4 | 1.85 | 1.30 | 1.08 | 1.22 | 2.12 | 2.60 | 2.75 | 2.95 | 2.85 | 1.90 | 1.00 | 1.05 |
| 5 | 1.85 | 1.25 | 1.12 | 1.22 | 2.12 | 2.42 | 2.82 | 2.90 | 2.82 | 2.08 | 1.05 | 1.05 |
| 6 | 1.78 | 1.20 | 1.15 | 1.18 | 2.20 | 2.40 | 2.75 | 2.50 | 4.32 | 2.25 | 1.00 | 1.08 |
| 7 | 1.58 | 1.20 | 1.15 | 1.22 | 2.42 | 2.48 | 2.30 | 2.25 | 2.78 | 2.28 | .98 | 1.10 |
| 8 | 1.45 | 1.28 | 1.12 | 1.25 | 2.40 | 2.72 | 2.40 | 2.20 | 2.08 | 2.35 | 1.00 | 1.10 |
| 9 | 1.40 | 1.38 | 1.10 | 1.38 | 2.38 | 2.70 | 2.75 | 2.20 | 2.15 | 2.40 | 1.02 | 1.20 |
| 10 | 1.52 | 1.25 | 1.15 | 1.38 | 2.30 | 2.52 | 3.40 | 2.12 | 2.18 | 2.32 | 1.05 | 1.22 |
| 11 | 1.60 | 1.22 | 1.42 | 1.50 | 2.38 | 2.45 | 2.95 | 2.40 | 2.32 | 2.40 | 1.00 | 1.15 |
| 12 | 1.45 | 1.40 | 1.25 | 1.75 | 2.45 | 3.05 | 2.35 | 2.60 | 2.40 | 2.32 | 1.10 | 1.25 |
| 13 | 1.55 | 1.35 | 1.00 | 1.75 | 2.70 | 3.25 | 2.30 | 2.85 | 2.40 | 2.15 | 1.00 | (a) |
| 14 | 1.45 | 1.40 | 1.00 | 1.90 | 3.00 | 3.05 | 2.15 | 3.40 | 2.28 | 2.00 | .95 | ..... |
| 15 | 1.40 | 1.35 | 1.02 | 1.75 | 2.98 | 3.22 | 2.10 | 3.90 | 2.12 | 2.00 | 1.02 | ..... |
| 16 | 1.40 | 1.30 | 1.10 | 1.85 | 2.72 | 2.95 | 2.00 | 3.90 | 2.05 | 1.98 | 1.12 | ..... |
| 17 | 1.42 | 1.28 | 1.02 | 1.98 | 2.48 | 3.00 | 1.90 | 3.75 | 2.00 | 2.02 | 1.10 | ..... |
| 18 | 1.40 | 1.30 | 1.12 | 2.18 | 2.50 | 2.85 | 1.70 | 3.60 | 2.08 | 2.10 | 1.00 | ..... |
| 19 | 1.30 | 1.25 | 1.15 | 2.12 | 2.55 | 3.12 | 1.70 | 4.35 | 1.98 | 2.08 | 1.02 | ..... |
| 20 | 1.40 | 1.20 | 1.10 | 2.12 | 2.95 | 2.95 | 1.68 | 4.30 | 1.80 | 2.00 | 1.00 | ..... |
| 21 | 1.40 | 1.12 | 1.20 | 1.90 | 2.68 | 2.88 | 1.70 | 3.80 | 1.62 | 1.92 | 1.10 | ..... |
| 22 | 1.50 | 1.18 | 1.12 | 1.88 | 2.70 | 2.70 | 1.80 | 3.15 | 1.55 | 2.00 | 1.10 | ..... |
| 23 | 1.28 | 1.12 | 1.10 | 1.92 | 3.48 | 2.62 | 1.75 | 2.90 | 1.60 | 2.08 | 1.00 | ..... |
| 24 | 1.20 | 1.28 | 1.08 | 1.75 | 3.50 | 2.50 | 4.85 | 2.80 | 1.50 | 2.15 | 1.10 | ..... |
| 25 | 1.18 | 1.22 | 1.00 | 1.62 | 3.25 | 2.60 | 2.50 | 2.80 | 1.60 | 2.18 | 1.15 | ..... |
| 26 | 1.30 | 1.38 | 1.08 | 1.75 | 2.90 | 2.55 | 1.88 | 2.50 | 1.68 | 2.08 | 1.02 | ..... |
| 27 | 1.40 | 1.42 | 1.12 | 1.85 | 2.72 | 2.50 | 2.35 | 2.60 | 1.80 | 2.00 | 1.05 | ..... |
| 28 | 1.35 | 1.30 | 1.08 | 1.98 | 2.62 | 3.10 | 2.70 | 2.85 | 1.95 | 1.88 | 1.18 | ..... |
| 29 | 1.30 | 1.25 | 1.12 | 2.15 | 2.50 | 3.50 | 2.70 | 3.60 | 2.02 | 1.65 | 1.20 | ..... |
| 30 | 1.55 | ..... | 1.10 | 1.90 | 2.58 | 3.05 | 2.45 | 3.80 | 2.10 | 1.55 | 1.12 | ..... |
| 31 | 2.48 | ..... | 1.18 | ..... | 2.75 | ..... | 2.65 | 3.60 | ..... | 1.42 | ..... | ..... |

[a] River frozen during remainder of year.

*Rating table for South Platte River at South Platte, Colo., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 20 | 2.00 | 287 | 3.00 | 600 | 4.00 | 958 |
| 1.00 | 37 | 2.10 | 317 | 3.10 | 634 | 4.10 | 997 |
| 1.10 | 54 | 2.20 | 347 | 3.20 | 668 | 4.20 | 1,037 |
| 1.20 | 75 | 2.30 | 377 | 3.30 | 702 | 4.30 | 1,077 |
| 1.30 | 98 | 2.40 | 407 | 3.40 | 738 | 4.40 | 1,117 |
| 1.40 | 121 | 2.50 | 438 | 3.50 | 774 | 4.50 | 1,157 |
| 1.50 | 147 | 2.60 | 470 | 3.60 | 810 | 4.60 | 1,198 |
| 1.60 | 173 | 2.70 | 502 | 3.70 | 846 | 4.70 | 1,240 |
| 1.70 | 200 | 2.80 | 534 | 3.80 | 883 | 4.80 | 1,284 |
| 1.80 | 228 | 2.90 | 567 | 3.90 | 920 | 4.90 | 1,330 |
| 1.90 | 257 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904. It is not well defined.

*Estimated monthly discharge of South Platte River at South Platte, Colo., for 1904.*

[Drainage area, 2,612 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 432 | 71 | 155 | 9,531 | 0.059 | 0.068 |
| February | 476 | 58 | 129 | 7,420 | .049 | .053 |
| March | 126 | 37 | 60.4 | 3,714 | .023 | .027 |
| April | 341 | 58 | 196 | 11,660 | .075 | .084 |
| May | 685 | 214 | 470 | 28,900 | .180 | .208 |
| June | 792 | 407 | 541 | 32,190 | .207 | .231 |
| July | 1,307 | 195 | 421 | 25,890 | .161 | .186 |
| August | 1,097 | 323 | 633 | 38,920 | .242 | .279 |
| September | 1,085 | 147 | 366 | 21,780 | .140 | .156 |
| October | 407 | 126 | 301 | 18,510 | .115 | .133 |
| November | 103 | 28 | 49.3 | 2,934 | .019 | .021 |
| December 1–12 | 86 | 37 | 56.7 | 1,350 | .022 | .0098 |
| The period | 1,307 | 28 | ..... | 202,800 | ..... | ..... |

## SOUTH PLATTE RIVER AT DENVER, COLO.

In the spring of 1895 a river station was established at the Twenty-third Street Viaduct in the city of Denver, but observations were discontinued on June 18, as the location was found to be unfavorable for accurate measurements, and the water had fallen below the gage. In July a station was established at the Fifteenth Street Bridge and observations were begun, these being made in the morning and in the afternoon. Stream measurements were then made from the lower side of the bridge. The original gage consisted of two 6 by 2 inch timbers spiked together, inclined and graduated to vertical tenths of a foot. The space between the marks was 0.156 foot. The timbers were fastened to posts driven into the bank. The bench mark is 107 feet southwest from the gage and is a cross mark on top of the east abutment of the Fifteenth Street Bridge on the north corner. It is marked "B. M." and is 6.15 feet above the 9-foot mark of the original Fifteenth street gage rod, which has since been destroyed.

Another inclined gage rod, reading the same as the one on the right bank, was placed on the left side in August, 1898. It consisted of a 4 by 4 inch timber 12 feet long fastened to posts driven into the left bank and graduated to vertical feet and tenths.

This rod was washed out by the high water of June, 1900, which also removed the sand bar in front of the rod on the right-hand side, making it available at low-water stages, and since that time the readings have been taken from the latter rod, or from rods which replaced it and which were located at the same point.

May 15, 1901, a T-rail was placed on the site of the latter rod, which was stolen. The rail was embedded in an inclined position in the slag bank. All readings were taken from this rod from May 15, 1901, to June 9, 1903, when the rod was again stolen. On June 10, 1903, a vertical 4 by 4 inch timber was placed at the same point and fastened to a cottonwood tree. The zero of the rod was placed at the same elevation as the zero of the old gage. It is read twice each day by Clarence Crisman.

The present gage and the bridge from which measurements are made are located at a point immediately below the mouth of Cherry Creek, which enters between the Fourteenth and Fifteenth Street bridges. The stream at this point is confined between artificial embankments of furnace slag.

Discharge measurements are made by wading at a point below or above the gage at low water and from the Fifteenth Street Bridge at high water. The initial point for soundings is the edge of the right abutment of the Fifteenth Street Bridge. The channel is straight for 100 feet above and for 500 feet below the station. The current is swift at high stages, but becomes sluggish at low stages. The banks

are slag embankments and can only overflow at extreme flood stages. The bed is composed of sand, free from vegetation, but very shifting. The bench mark is the top of the capstone on the south end of the southeast abutment of the Sixteenth Street Viaduct on the right bank below the gage. Its elevation is 12.00 feet above the zero of the gage.

This station is important principally from the fact that it is used as a training station for instructing young hydrographers in the Denver office in the use of the current meter in field practice.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of South Platte River at Denver, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| January 18 | M. C. Hinderlider | 26 | 35 | 2.09 | 0.73 | 73 |
| February 3 | T. E. Brick | 49 | 48 | 1.50 | .70 | 72 |
| February 3 | do | 26 | 34 | 2.09 | .70 | 71 |
| February 15 | do | 26 | 35 | 1.94 | .68 | 68 |
| February 15 | do | 26 | 35 | 2.11 | .72 | 74 |
| February 27 | G. B. Monk | 24 | 33 | 2.33 | .78 | 78 |
| February 27 | M. P. Beeson | 24 | 33 | 2.33 | .77 | 77 |
| March 19 | G. E. Moore | 22 | 33 | 1.73 | .70 | 57 |
| March 19 | T. E. Brick | 22 | 33 | 1.70 | .70 | 56 |
| April 9 | G. B. Monk | 25 | 32 | 1.41 | .70 | 45 |
| April 20 | do | 28 | 39 | 2.38 | 1.00 | 93 |
| May 5 | M. P. Beeson | 61 | 109 | 2.50 | 1.60 | 270 |
| May 5 | do | 60 | 108 | 2.51 | 1.60 | 271 |
| May 13 | T. E. Brick | 62 | 135 | 2.83 | 1.90 | 382 |
| June 3 | do | 196 | 406 | 4.19 | 3.45 | 1,701 |
| June 4 | T. Tobish | 181 | 322 | 4.11 | 2.98 | 1,325 |
| June 20 | M. P. Beeson | 71 | 140 | 3.09 | 1.75 | 433 |
| June 20 | do | 71 | 141 | 3.09 | 1.78 | 436 |
| June 25 | do | 71 | 105 | 2.43 | 1.45 | 255 |
| June 29 | do | 88 | 166 | 3.87 | 2.38 | 643 |
| July 6* | G. B. Monk | 85 | 186 | 3.15 | 2.20 | 585 |
| July 25 | R. I. Meeker | 92 | 178 | 3.58 | 2.45 | 637 |
| July 29 | M. P. Beeson | 88 | 148 | 3.61 | 2.25 | 535 |
| August 15 | T. E. Brick | 95 | 167 | 4.17 | 2.50 | 697 |
| September 1 | M. P. Beeson | 85 | 123 | 3.12 | 1.92 | 384 |
| September 1 | do | 85 | 126 | 2.92 | 1.85 | 368 |
| October 27 | G. E. Moore | 34 | 36 | 3.61 | 1.00 | 130 |
| November 19 | M. P. Beeson | 68 | 75 | 1.96 | 1.20 | 147 |

NOTE.—The area and mean velocities are not comparable as measurements were made at different sections.

*Mean daily discharge* [a], *in second-feet, of South Platte River at Denver, Colo., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 76 | 68 | 92 | 59 | 195 | 505 | 416 | 384 | 398 | 407 | 108 | 132 |
| 2 | 80 | 72 | 82 | 58 | 287 | 252 | 328 | 398 | 335 | 309 | 104 | 132 |
| 3 | 82 | 70 | 89 | 47 | 376 | 1,000 | 305 | 384 | 384 | 309 | 102 | 128 |
| 4 | 76 | 72 | 81 | 59 | 320 | 1,170 | 625 | 597 | 335 | 198 | 108 | 109 |
| 5 | 70 | 68 | 80 | 58 | 298 | 520 | 566 | 305 | 412 | 117 | 139 | 111 |
| 6 | 61 | 68 | 66 | 53 | 242 | 407 | 625 | 324 | 384 | 147 | 120 | 102 |
| 7 | 72 | 68 | 76 | 45 | 159 | 273 | 475 | 324 | 343 | 118 | 109 | 102 |
| 8 | 70 | 64 | 75 | 52 | 430 | 291 | 398 | 305 | 235 | 139 | 108 | 111 |
| 9 | 72 | 72 | 68 | 54 | 287 | 500 | 242 | 235 | 235 | 164 | 120 | 104 |
| 10 | 76 | 64 | 57 | 51 | 242 | 625 | 168 | 192 | 235 | 176 | 145 | 109 |
| 11 | 70 | 64 | 66 | 47 | 287 | 490 | 324 | 220 | 154 | 154 | 122 | 82 |
| 12 | 68 | 76 | 69 | 49 | 363 | 657 | 320 | 220 | 206 | 132 | 113 | 80 |
| 13 | 70 | 80 | 49 | 59 | 262 | 705 | 316 | 269 | 143 | 122 | 104 | 80 |
| 14 | 76 | 80 | 70 | 62 | 324 | 604 | 269 | 407 | 113 | 104 | 139 | 80 |
| 15 | 82 | 72 | 50 | 61 | 560 | 604 | 287 | 705 | 99 | 96 | 186 | 70 |
| 16 | 82 | 64 | 45 | 64 | 455 | 536 | 220 | 900 | 96 | 106 | 171 | 64 |
| 17 | 82 | 68 | 48 | 69 | 351 | 455 | 186 | 750 | 82 | 104 | 145 | 89 |
| 18 | 72 | 68 | 50 | 178 | 252 | 465 | 171 | 625 | 154 | 104 | 124 | 89 |
| 19 | 82 | 68 | 57 | 88 | 313 | 460 | 83 | 536 | 113 | 122 | 108 | 80 |
| 20 | 76 | 72 | 56 | 99 | 363 | 440 | 161 | 510 | 93 | 117 | 139 | 85 |
| 21 | 72 | 70 | 54 | 109 | 407 | 470 | 242 | 450 | 117 | 126 | 122 | 82 |
| 22 | 70 | 68 | 59 | 134 | 455 | 430 | 128 | 328 | 154 | 113 | 106 | 72 |
| 23 | 51 | 68 | 63 | 93 | 455 | 393 | 198 | 309 | 262 | 150 | 102 | 85 |
| 24 | 61 | 82 | 55 | 95 | 560 | 269 | 566 | 273 | 269 | 164 | 106 | 93 |
| 25 | 68 | 76 | 62 | 102 | 490 | 287 | 800 | 355 | 305 | 164 | 106 | 82 |
| 26 | 70 | 85 | 59 | 117 | 343 | 269 | 578 | 313 | 287 | 159 | 117 | 82 |
| 27 | 64 | 61 | 56 | 186 | 750 | 324 | 355 | 276 | 276 | 136 | 126 | 72 |
| 28 | 61 | 85 | 60 | 145 | 324 | 214 | 320 | 294 | 276 | 130 | 130 | 235 |
| 29 | 61 | 93 | 54 | 139 | 212 | 440 | 455 | 520 | 269 | 126 | 130 | 113 |
| 30 | 61 | ..... | 59 | 192 | 287 | 413 | 363 | 510 | 252 | 124 | 139 | 99 |
| 31 | 68 | ..... | 59 | ..... | 430 | ..... | 384 | 470 | ..... | 108 | ..... | 89 |

[a] Daily discharges obtained indirectly, according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.

*Estimated monthly discharge of South Platte River at Denver, Colo., for 1904.*

[Drainage area, 3,840 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 82 | 51 | 71.0 | 4,366 | 0.018 | 0.021 |
| February | 93 | 61 | 71.9 | 4,136 | .019 | .020 |
| March | 92 | 45 | 63.4 | 3,898 | .017 | .020 |
| April | 192 | 45 | 87.5 | 5,207 | .023 | .026 |
| May | 750 | 159 | 357 | 21,950 | .093 | .107 |
| June | 1,170 | 214 | 482 | 28,680 | .126 | .141 |
| July | 800 | 83 | 351 | 21,580 | .091 | .105 |
| August | 900 | 192 | 409 | 25,150 | .107 | .123 |
| September | 412 | 82 | 234 | 13,920 | .061 | .068 |
| October | 407 | 96 | 153 | 9,408 | .040 | .046 |
| November | 186 | 102 | 123 | 7,319 | .032 | .036 |
| December | 235 | 64 | 98.2 | 6,038 | .026 | .030 |
| The year | 1,170 | 45 | 209 | 151,700 | .054 | .743 |

## SOUTH PLATTE RIVER NEAR JULESBURG, COLO.

This station was established April 2, 1902, by John E. Field, at the wagon bridge crossing South Platte River, about 1 mile southeast of Julesburg, Colo., a station at the junction of the main line and Denver Branch of the Union Pacific Railroad. As this is the last station on South Platte River in Colorado, and is also below all irrigation ditches in Colorado taking water from the South Platte, with the exception of one, it is of considerable importance for securing data relative to the flow of return waters as well as the natural flow in the main channel. However, the conditions at this station are not as desirable as they should be, owing to the great width of the channel and the general instability of the bed of the stream, features characteristic of the whole course of South Platte River through this part of the State. The channel at this point is about one-half mile wide, and at low stages of the river it is badly broken up by islands, causing the stream to flow in several different channels. The banks are low, but do not overflow. The bed of the river is dry during the greater part of the year. The gage heights from March 15 to March 31, and from November 25 to December 31, 1903, were affected by ice gorges and anchor ice, so that no rating table could be constructed for those periods. The gage is a 2 by 4 inch vertical timber spiked to a pile of the bridge about 600 feet from the north end. It is read once each day by T. W. Jenkins.

Discharge measurements are made at high water from the bridge, which is one-half mile long and is supported on piles at intervals of 20 feet. The initial point for soundings is the north abutment on the left bank. The channel is straight for 600 feet above and 400 feet below the station. The right bank is low, but is not liable to overflow. The left bank overflows only at very high stages. The section is broad and shallow, with a sandy, changeable bed. The channel is broken by islands at ordinary stages, and is covered with undergrowth and vegetation. At low water it is impossible to measure the velocity in the many small channels and the discharge has to be estimated. The bench mark is a 20-penny nail driven into the south face of the cap on the piling to which the gage is spiked. It is directly over the gage rod and is inclosed in a circle of white paint and marked "B. M." Its elevation is 8.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of South Platte River near Julesburg, Colo., in 1904.*

| Date. | Hydrographer. | Mean velocity. | Discharge. |
|---|---|---|---|
| | | *Ft. per sec.* | *Second-feet.* |
| March 8 | M. C. Hinderlider | 1.35 | 88 |
| March 16 | T. W. Jenkins | 1.18 | 19 |
| March 26 | do | 1.18 | 23 |
| April 2 | do | 1.17 | 15 |
| April 9 | do | 1.18 | 16 |
| April 16 | do | 1.10 | 12 |
| April 30 | do | 1.42 | 65 |
| May 9 | do | 2.02 | 546 |
| May 27 | do | 1.76 | 228 |
| June 3 | do | 2.60 | 1,542 |
| June 7 | do | 2.98 | 2,988 |

*Mean daily gage height, in feet, of South Platte River near Julesburg, Colo., for 1904.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.90 | 1.15 | 1.40 | 2.00 | 2.10 | 1.30 | 1.30 | 1.60 | 1.40 | 1.65 |
| 2 | 1.75 | 1.15 | 1.30 | 2.61 | 1.85 | 1.30 | 1.30 | 1.60 | 1.35 | 1.65 |
| 3 | 1.65 | 1.15 | 1.30 | 2.50 | 1.85 | 2.15 | 1.25 | 1.55 | 1.35 | 1.60 |
| 4 | 1.55 | 1.15 | 1.30 | 2.20 | 1.75 | 1.40 | 1.25 | 1.50 | 1.30 | 1.60 |
| 5 | 1.60 | 1.20 | 1.40 | 2.00 | 1.65 | 1.35 | 1.20 | 1.50 | 1.30 | 1.75 |
| 6 | 1.60 | 1.20 | 1.40 | 3.15 | 1.60 | 1.35 | 1.20 | 1.45 | 1.30 | 1.80 |
| 7 | 1.45 | 1.20 | 1.35 | 3.00 | 1.85 | 1.35 | 1.20 | 1.45 | 1.30 | 1.75 |
| 8 | 1.35 | 1.20 | 1.35 | 3.20 | 1.80 | 1.30 | 1.20 | 1.65 | 1.30 | 1.85 |
| 9 | 1.35 | 1.20 | 2.00 | 3.00 | 1.70 | 1.30 | 1.20 | 1.60 | 1.30 | 1.85 |
| 10 | 1.30 | 1.20 | 1.80 | 2.90 | 1.60 | 1.30 | 1.20 | 1.55 | 1.30 | 1.85 |
| 11 | 1.25 | 1.20 | 1.70 | 2.65 | 1.60 | 1.25 | 1.20 | 1.55 | 1.30 | 1.85 |
| 12 | 1.20 | 1.15 | 1.60 | 2.55 | 1.95 | 1.25 | 1.20 | 1.50 | 1.30 | 1.85 |
| 13 | 1.20 | 1.15 | 1.45 | 2.50 | 1.90 | 1.25 | 1.20 | 1.40 | 1.30 | 1.85 |
| 14 | 1.20 | 1.15 | 1.40 | 2.75 | 1.80 | 1.25 | 1.20 | 1.40 | 1.35 | 1.90 |
| 15 | 1.20 | 1.00 | 1.35 | 2.80 | 1.60 | 1.25 | 1.15 | 1.35 | 1.40 | 1.90 |
| 16 | 1.20 | 1.00 | 1.35 | 2.70 | 1.55 | 1.20 | 1.15 | 1.30 | 1.65 | (a) |
| 17 | 1.20 | 1.00 | 1.30 | 2.70 | 1.50 | 1.20 | 1.15 | 1.30 | 1.60 | ..... |
| 18 | 1.20 | 1.00 | 1.30 | 2.70 | 1.45 | 1.35 | 1.15 | 1.40 | 1.55 | ..... |
| 19 | 1.20 | 1.00 | 1.30 | 2.70 | 1.45 | 1.30 | 1.15 | 1.45 | 1.55 | ..... |
| 20 | 1.20 | 1.15 | 1.30 | 2.65 | 1.60 | 1.25 | 1.15 | 1.40 | 1.55 | ..... |
| 21 | 1.20 | 1.20 | 1.30 | 2.60 | 1.60 | 1.25 | 1.15 | 1.35 | 1.55 | ..... |
| 22 | 1.20 | 1.20 | 1.30 | 2.55 | 1.60 | 1.25 | 1.15 | 1.30 | 1.60 | ..... |
| 23 | 1.20 | 1.20 | 1.30 | 2.50 | 1.60 | 1.20 | 1.15 | 1.30 | 1.60 | ..... |
| 24 | 1.20 | 1.20 | 1.30 | 2.45 | 1.60 | 1.20 | 1.15 | 1.30 | 1.65 | ..... |
| 25 | 1.20 | 1.25 | 1.30 | 2.40 | 1.60 | 1.20 | 1.15 | 1.30 | 1.80 | ..... |
| 26 | 1.20 | 1.20 | 1.30 | 2.40 | 1.55 | 1.20 | 1.15 | 1.30 | 1.80 | ..... |
| 27 | 1.20 | 1.15 | 1.75 | 2.35 | 1.50 | 1.20 | 1.15 | 1.30 | 1.80 | ..... |
| 28 | 1.20 | 1.00 | 1.60 | 2.30 | 1.50 | 1.20 | 1.15 | 1.35 | 1.75 | ..... |
| 29 | 1.20 | 1.20 | 1.60 | 2.25 | 1.45 | 1.20 | 1.15 | 1.55 | 1.75 | ..... |
| 30 | 1.15 | 1.45 | 1.65 | 2.20 | 1.35 | 1.20 | 1.65 | 1.50 | 1.70 | ..... |
| 31 | 1.15 | ..... | 1.80 | ..... | 1.30 | 1.20 | ..... | 1.45 | ..... | ..... |

a Frozen during remainder of year.

*Rating table for South Platte River near Julesburg, Colo., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 4 | 1.45 | 75 | 1.85 | 315 | 2.50 | 1,315 |
| 1.05 | 7 | 1.50 | 95 | 1.90 | 360 | 2.60 | 1,550 |
| 1.10 | 10 | 1.55 | 115 | 1.95 | 410 | 2.70 | 1,830 |
| 1.15 | 15 | 1.60 | 140 | 2.00 | 465 | 2.80 | 2,200 |
| 1.20 | 20 | 1.65 | 165 | 2.10 | 590 | 2.90 | 2,620 |
| 1.25 | 25 | 1.70 | 195 | 2.20 | 735 | 3.00 | 3,060 |
| 1.30 | 35 | 1.75 | 230 | 2.30 | 905 | 3.10 | 3,530 |
| 1.35 | 45 | 1.80 | 270 | 2.40 | 1,100 | 3.20 | 4,040 |
| 1.40 | 60 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1 foot and 3 feet.

*Estimated monthly discharge of South Platte River near Julesburg, Colo., for 1904.*

[Drainage area, 20,600 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March | 360 | 15 | 56.9 | 3,499 | 0.0028 | 0.0032 |
| April | 75 | 4 | 17.3 | 1,029 | .00084 | .00094 |
| May | 465 | 35 | 95.6 | 5,878 | .0046 | .0053 |
| June | 4,040 | 465 | 1,663 | 98,960 | .081 | .090 |
| July | 590 | 35 | 182 | 11,190 | .0088 | .010 |
| August | 660 | 20 | 49.4 | 3,038 | .0024 | .0028 |
| September | 165 | 15 | 23.7 | 1,410 | .0012 | .0013 |
| October | 165 | 35 | 76.8 | 4,722 | .0037 | .0043 |
| November | 270 | 35 | 109 | 6,486 | .0053 | .0059 |
| December 1–15 | 360 | 140 | 263 | 7,824 | .013 | .0072 |
| The period | | | | 144,000 | | |

## CLEAR CREEK AT FORKSCREEK, COLO.

This station was originaly established May 29, 1899, by John E. Field. The station is located at the United States Geological Survey footbridge just below the Colorado and Southern Railroad bridge near the railroad station, and is an important station on account of its location above all diversions on this stream, which is entirely used for power and irrigation purposes. The chain gage is fastened to the wooden cribwork on the left bank 30 feet below the footbridge. The length of the chain from the end of the weight to the marker is 20.25 feet. Discharge measurements are made from the single-span footbridge. The initial point for soundings is a brass-headed nail on the rail of the bridge at the north end. It is marked zero with white paint. The channel is straight for 30 feet above and 150 feet below the station. Both banks are high and are not liable to overflow. The right bank is the side of the mountain and the left bank is the retaining wall of the railroad embankment. The bed of the stream is composed of small cobblestones and bowlders, with some silt at low stages. The current is rapid and it is necessary to use a stay wire on the meter at high stages. The bench mark, established October 8, 1903, is a cross cut in the top of the downstream stringer over the first strut from the south end of the footbridge. When established its elevation above the gage datum was 14.73 feet. The gage is read twice each day by C. W. Hoisington.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Clear Creek at Forkscreek, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | | *Square feet.* | *Ft. per sec.* | *Feet.* | *Second-feet.* |
| March 19[a] | R. I. Meeker | | | | | 43 |
| April 14 | G. B. Monk | 30 | 33 | 3.42 | 2.00 | 113 |
| May 4 | T. E. Brick | 30 | 41 | 5.17 | 2.52 | 212 |
| May 24 | do | 36 | 104 | 10.75 | 3.85 | 1,118 |
| July 26 | do | 34 | 70 | 7.23 | 3.35 | 506 |
| August 16 | do | 34 | 65 | 5.80 | 3.10 | 377 |
| September 20 | G. B. Monk | 30 | 54 | 4.17 | 2.60 | 225 |
| September 20 | M. P. Beeson | 30 | 54 | 4.35 | 2.60 | 235 |

[a] North and South forks.

*Mean daily gage height, in feet, of Clear Creek at Forkscreek, Colo., for 1904.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.90 | 2.52 | 3.80 | 3.85 | 3.35 | 3.22 | 2.78 |
| 2 | 1.90 | 2.72 | 3.80 | 3.80 | 3.15 | 3.18 | 2.78 |
| 3 | 1.92 | 2.70 | 3.72 | 3.70 | 3.08 | 3.18 | 2.75 |
| 4 | 1.90 | 2.55 | 3.55 | 3.70 | 3.08 | 3.12 | 2.72 |
| 5 | 1.92 | 2.52 | 3.45 | 3.70 | 3.08 | 3.10 | 2.65 |
| 6 | 1.90 | 2.62 | 3.42 | 3.68 | 3.02 | 3.02 | 2.65 |
| 7 | 1.82 | 2.72 | 3.55 | 3.68 | 3.00 | 3.00 | 2.65 |
| 8 | 1.85 | 2.70 | 3.72 | 3.62 | 3.02 | 3.00 | 2.70 |
| 9 | 1.75 | 2.70 | 3.75 | 3.65 | 2.92 | 2.98 | 2.68 |
| 10 | 1.88 | 2.68 | 3.65 | 3.62 | 2.90 | 2.92 | 2.65 |
| 11 | 2.02 | 2.72 | 3.75 | 3.65 | 2.90 | 2.98 | 2.65 |
| 12 | 2.12 | 2.88 | 3.90 | 3.65 | 3.12 | 2.90 | 2.60 |
| 13 | 2.18 | 2.88 | 4.15 | 3.58 | 3.10 | 2.85 | 2.60 |
| 14 | 2.22 | 2.98 | 4.15 | 3.55 | 3.20 | 2.85 | 2.60 |
| 15 | 2.22 | 2.95 | 4.05 | 3.48 | 3.20 | 2.85 | 2.60 |
| 16 | 2.08 | 2.90 | 4.22 | 3.45 | 3.10 | 3.02 | 2.60 |
| 17 | 2.18 | 2.88 | 4.20 | 3.45 | 3.10 | 2.90 | 2.60 |
| 18 | 2.22 | 3.00 | 4.22 | 3.45 | 3.35 | 2.82 | 2.60 |
| 19 | 2.32 | 3.08 | 4.25 | 3.38 | 3.20 | 2.80 | 2.60 |
| 20 | 2.40 | 3.22 | 4.32 | 3.35 | 3.18 | 2.80 | 2.70 |
| 21 | 2.50 | 3.22 | 4.20 | 3.35 | 3.20 | 2.80 | 2.65 |
| 22 | 2.32 | 3.28 | 4.15 | 3.40 | 3.18 | 2.80 | 2.60 |
| 23 | 2.28 | 3.52 | 4.05 | 3.30 | 3.05 | 2.80 | 2.55 |
| 24 | 2.28 | 3.95 | 4.00 | 3.42 | 3.00 | 2.78 | 2.50 |
| 25 | 2.35 | 3.95 | 3.95 | 3.45 | 3.00 | 2.70 | 2.55 |
| 26 | 2.35 | 3.72 | 3.85 | 3.35 | 3.12 | 2.70 | 2.50 |
| 27 | 2.42 | 3.60 | 3.85 | 3.30 | 3.22 | 2.70 | 2.50 |
| 28 | 2.52 | 3.58 | 3.82 | 3.40 | 3.12 | 2.72 | 2.50 |
| 29 | 2.55 | 3.50 | 3.85 | 3.28 | 3.10 | 2.82 | 2.50 |
| 30 | 2.50 | 3.72 | 3.88 | 3.28 | 3.10 | 2.82 | 2.50 |
| 31 | | 3.85 | | 3.18 | 3.18 | | 2.50 |

*Rating table for Clear Creek at Forkscreek, Colo., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 92 | 2.20 | 139 | 3.00 | 340 | 3.70 | 820 |
| 1.75 | 95 | 2.30 | 155 | 3.10 | 380 | 3.80 | 935 |
| 1.80 | 98 | 2.40 | 173 | 3.20 | 430 | 3.90 | 1,060 |
| 1.85 | 101 | 2.50 | 192 | 3.30 | 485 | 4.00 | 1,190 |
| 1.90 | 105 | 2.60 | 216 | 3.40 | 550 | 4.10 | 1,330 |
| 1.95 | 109 | 2.70 | 240 | 3.50 | 625 | 4.20 | 1,470 |
| 2.00 | 113 | 2.80 | 268 | 3.60 | 720 | 4.30 | 1,610 |
| 2.10 | 125 | 2.90 | 300 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1904. It is fairly well defined between gage heights 2 feet and 3.5 feet. The table has been extended beyond these limits.

*Estimated monthly discharge of Clear Creek at Forkscreek, Colo., for 1904.*

[Drainage area, 345 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 204 | 99 | 139 | 8,271 | 0.403 | 0.450 |
| May | 1,125 | 197 | 453 | 27,850 | 1.31 | 1.51 |
| June | 1,638 | 564 | 1,092 | 64,980 | 3.17 | 3.54 |
| July | 995 | 420 | 651 | 40,030 | 1.89 | 2.18 |
| August | 515 | 300 | 385 | 23,670 | 1.12 | 1.29 |
| September | 440 | 240 | 308 | 18,330 | .893 | .996 |
| October | 262 | 192 | 219 | 13,470 | .635 | .732 |
| The period | | | | 196,600 | | |

## LOUP RIVER AT COLUMBUS, NEBR.

Observations at this station were begun October 13, 1894. The station was established by O. V. P. Stout. It is located about 75 yards above the Union Pacific Railroad bridge and about 6 miles above the mouth of the river. There is an island about 1,000 feet above the gaging section. Discharge measurements are made by means of a five-eighths inch cable and car. The cable is fastened to a large tree, and is supported by a post on the west bank. On the east bank it is anchored to a timber set in the ground. Distances from the initial point are marked in red paint on the cable at 12½-foot intervals. The initial

point for soundings is the zero mark on the cable. The channel is straight for 1,000 feet above and 300 feet below the cable. At a point 150 feet below the cable the current is broken by old piling and masonry piers of a railroad bridge. The section at the gage is broad and shallow, with rapid velocity and a shifting, sandy bed. The right bank is low, sandy, covered with willows and brush, and is liable to overflow at very high stages. The left bank is about 10 feet high and is not liable to overflow. Two gages are maintained at this station since in times of high flood or ice gorges the upper one often becomes inaccessible.

The upper gage is a vertical rod 12 feet long bolted to piling 160 feet above the railroad bridge on the left bank.

The lower gage is of the regulation chain and weight type and was installed June 24, 1904, at the highway bridge south of Columbus about 1½ miles below the upper gage at the Union Pacific Railroad bridge. The distance from the end of the weight to the index is 24.50 feet.

Bench mark No. 1 is a standard 4-foot iron post of the Geological Survey, located 72 feet east of the upper gage. Its elevation is 21.83 feet above the zero of the lower gage and 13.27 feet above the zero of the upper gage. On account of the constantly changing cross section a large number of discharge measurements are necessary to obtain the daily discharge with a fair degree of accuracy. In order to render the readings of the two gages comparable the fall of the river was very carefully determined between the two and found to be 8.56 feet. The lower gage was then set to read the same as the upper gage; that is, a difference of 8.56 feet exists between the zeros of the two gages, but the bench marks are referred to the same datum; that is, to the zero of the lower gage. Bench mark No. 2 was also established on the above date at the lower gage and is a cross cut on the west end of the cap of the first bent of the north bridge approach. Its elevation above gage datum is 10.91 feet.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of Loup River at Columbus, Nebr., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 25 | J. C. Stevens | 525 | 961 | 3.23 | 4.75 | 3,099 |
| May 8 | do | | 1,293 | 2.69 | 5.31 | 3,483 |
| June 18 | do | 520 | 1,065 | 3.24 | 4.85 | 3,442 |
| June 25 | do | 506 | 1,682 | 2.75 | 5.46 | 4,630 |
| July 29 | do | 514 | 1,130 | 2.57 | 4.82 | 2,896 |
| July 29 | do | 516 | 1,274 | 2.64 | 4.82 | 3,376 |
| July 31 | do | 512 | 1,084 | 2.52 | 4.77 | 2,737 |
| July 31 | do | 515 | 1,036 | 2.63 | 4.77 | 2,723 |
| July 31 | do | 515 | 1,067 | 2.60 | 4.77 | 2,778 |
| July 31 | do | 515 | 1,045 | 2.61 | 4.80 | 2,734 |
| July 31 | do | 515 | 1,020 | 2.44 | 4.80 | 2,492 |
| July 31 | do | 515 | 1,018 | 2.78 | 4.80 | 2,826 |
| September 2 | do | | 1,036 | 2.78 | 5.01 | 2,880 |

*Mean daily gage height, in feet, of Loup River at Columbus, Nebr., for 1904.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 4.95 | 4.95 | 4.70 | 4.90 | 4.52 | 4.90 | 5.10 | 4.45 |
| 2 | | 4.90 | 4.90 | 4.80 | 4.90 | 4.48 | 5.00 | 5.35 | 4.45 |
| 3 | | 4.92 | 4.90 | 5.10 | 4.90 | 4.71 | 5.60 | 5.30 | 4.40 |
| 4 | | 4.90 | 4.95 | 5.15 | 4.95 | 4.84 | 5.20 | 5.25 | 4.45 |
| 5 | | 4.90 | 4.95 | 5.20 | 5.00 | 4.87 | 5.00 | 5.10 | 4.45 |
| 6 | | 4.95 | 4.98 | 5.15 | 5.78 | 4.85 | 4.65 | 4.85 | 4.30 |
| 7 | | 5.00 | | 4.95 | 6.00 | 4.80 | 4.65 | 4.65 | 4.45 |
| 8 | | 5.20 | 5.30 | 4.95 | 6.25 | 4.85 | 4.65 | 4.65 | 4.55 |
| 9 | | 5.10 | 5.30 | 5.10 | 5.80 | 5.15 | 4.56 | 4.70 | 4.55 |
| 10 | | 5.05 | 5.25 | 7.30 | 6.49 | 5.15 | 4.48 | 4.95 | 4.60 |
| 11 | | 5.00 | 5.20 | 5.60 | 6.20 | 4.75 | 4.40 | 4.85 | 4.60 |
| 12 | | 5.00 | 5.15 | 5.40 | 5.42 | 4.65 | 4.50 | 5.00 | 4.60 |
| 13 | 5.35 | 4.95 | 5.15 | 5.30 | 4.96 | 4.55 | 4.50 | 4.90 | 4.60 |
| 14 | 5.35 | 4.90 | 5.15 | 5.80 | 4.82 | 4.50 | 4.50 | 4.80 | 4.55 |
| 15 | 5.30 | 4.90 | 5.15 | 5.40 | 4.72 | 4.42 | 5.10 | 4.80 | 4.60 |
| 16 | 5.10 | 4.90 | 5.05 | 5.20 | 4.60 | 4.45 | 4.60 | 4.75 | 4.60 |
| 17 | 5.00 | 4.90 | 5.00 | 5.00 | 4.75 | 4.50 | 4.55 | 4.70 | 4.60 |
| 18 | 4.95 | 4.95 | 5.00 | 4.85 | 6.30 | 4.60 | 4.45 | 5.10 | 4.65 |
| 19 | 4.90 | 4.95 | 5.00 | 4.90 | 5.11 | 4.72 | 4.55 | 6.30 | 4.60 |
| 20 | 4.85 | 5.00 | 5.00 | 4.80 | 5.10 | 4.77 | 4.50 | 6.10 | 4.69 |
| 21 | 4.80 | 5.05 | 5.00 | 4.90 | 5.10 | 4.85 | 4.60 | 5.00 | 4.65 |
| 22 | 4.80 | 5.05 | 5.00 | 4.75 | 5.80 | 4.65 | 4.70 | 4.80 | 4.65 |
| 23 | 4.80 | 5.10 | 4.98 | 4.60 | 4.80 | 4.45 | 4.70 | 4.80 | 4.65 |
| 24 | 4.80 | 5.15 | 5.00 | 4.75 | 4.70 | 4.40 | 4.60 | 4.55 | 4.80 |
| 25 | 4.75 | 5.40 | | 5.42 | 4.70 | 4.40 | 4.70 | 4.50 | 4.50 |
| 26 | 4.75 | 5.35 | 5.90 | 5.45 | 4.75 | 4.40 | 4.70 | 4.40 | 4.50 |
| 27 | 4.75 | 5.20 | 5.00 | 5.30 | 4.70 | 4.40 | 4.70 | 4.45 | |
| 28 | 4.80 | 5.05 | 4.90 | 5.10 | 4.95 | 4.40 | 4.90 | 4.40 | |
| 29 | 4.80 | 4.98 | 4.50 | 5.00 | 4.70 | 4.40 | 5.00 | 4.45 | |
| 30 | 4.89 | 4.95 | 4.50 | 4.92 | 4.64 | 4.45 | 5.00 | 4.50 | |
| 31 | 4.95 | | 4.50 | | 4.56 | 5.10 | | 4.45 | |

*Mean daily discharge, in second-feet, of Loup River at Columbus, Nebr., for 1904.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 3,550 | 2,740 | 2,500 | 2,740 | 2,150 | 2,740 | 3,260 | 1,740 |
| 2 | ..... | 3,400 | 2,500 | 2,740 | 2,740 | 2,150 | 2,870 | 4,090 | 1,740 |
| 3 | ..... | 3,400 | 2,500 | 3,710 | 2,740 | 2,620 | 4,960 | 3,890 | 1,660 |
| 4 | ..... | 3,260 | 2,620 | 3,890 | 2,870 | 3,000 | 3,400 | 3,710 | 1,740 |
| 5 | ..... | 3,260 | 2,500 | 4,090 | 3,000 | 3,000 | 3,000 | 3,260 | 1,740 |
| 6 | ..... | 3,400 | 2,620 | 3,890 | 6,060 | 3,000 | 2,150 | 2,620 | 1,510 |
| 7 | ..... | 3,550 | 3,000 | 3,400 | 7,050 | 2,870 | 2,150 | 2,150 | 1,740 |
| 8 | ..... | 4,300 | 3,400 | 3,400 | 9,250 | 3,000 | 2,150 | 2,150 | 1,930 |
| 9 | ..... | 3,710 | 3,400 | 3,890 | 6,060 | 3,890 | 1,930 | 2,260 | 1,930 |
| 10 | ..... | 3,550 | 3,260 | 20,000 | 11,750 | 3,710 | 1,820 | 2,870 | 2,040 |
| 11 | ..... | 3,400 | 3,130 | 6,060 | 9,250 | 2,620 | 1,660 | 2,620 | 2,040 |
| 12 | ..... | 3,400 | 3,130 | 5,400 | 4,520 | 2,380 | 1,820 | 3,000 | 2,040 |
| 13 | 5,400 | 3,260 | 3,130 | 4,960 | 3,000 | 2,150 | 1,820 | 2,740 | 2,040 |
| 14 | 5,400 | 3,000 | 3,130 | 7,400 | 2,620 | 2,040 | 1,820 | 2,500 | 1,930 |
| 15 | 5,180 | 3,000 | 3,130 | 5,400 | 2,380 | 1,820 | 3,260 | 2,500 | 2,040 |
| 16 | 4,300 | 3,000 | 3,000 | 4,520 | 2,150 | 1,820 | 2,040 | 2,380 | 2,040 |
| 17 | 3,890 | 3,000 | 2,870 | 3,890 | 2,380 | 1,930 | 1,930 | 2,260 | 2,040 |
| 18 | 3,710 | 3,000 | 2,870 | 3,400 | 10,250 | 2,150 | 1,740 | 3,260 | 2,150 |
| 19 | 3,550 | 3,000 | 2,870 | 3,400 | 3,550 | 2,380 | 1,930 | 9,750 | 2,040 |
| 20 | 3,400 | 3,130 | 3,000 | 3,000 | 3,550 | 2,500 | 1,820 | 7,800 | 2,260 |
| 21 | 3,260 | 3,260 | 3,000 | 3,130 | 3,550 | 2,740 | 2,040 | 3,000 | 2,150 |
| 22 | 3,260 | 3,260 | 3,000 | 2,620 | 6,500 | 2,150 | 2,260 | 2,500 | 2,150 |
| 23 | 3,260 | 3,260 | 3,000 | 2,150 | 2,740 | 1,740 | 2,760 | 2,500 | 2,150 |
| 24 | 3,260 | 3,400 | 3,000 | 2,380 | 2,500 | 2,660 | 2,040 | 1,930 | 2,500 |
| 25 | 3,130 | 4,300 | 4,750 | 4,300 | 2,500 | 1,660 | 2,260 | 1,820 | 1,820 |
| 26 | 3,130 | 4,090 | 6,500 | 4,520 | 2,740 | 1,660 | 2,260 | 1,660 | 1,820 |
| 27 | 3,130 | 3,550 | 3,130 | 3,890 | 2,620 | 1,660 | 2,260 | 1,740 | ..... |
| 28 | 3,260 | 3,000 | 2,870 | 3,260 | 3,260 | 1,660 | 2,740 | 1,660 | ..... |
| 29 | 3,260 | 2,870 | 1,930 | 3,000 | 2,620 | 1,660 | 3,000 | 1,740 | ..... |
| 30 | 3,260 | 2,740 | 1,930 | 2,740 | 2,500 | 1,740 | 3,130 | 1,820 | ..... |
| 31 | 3,550 | ..... | 2,040 | ..... | 2,820 | 3,260 | ..... | 1,740 | ..... |

NOTE.—Daily discharge obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.

*Estimated monthly discharge of Loup River at Columbus, Nebr., for 1904.*

[Drainage area, 13,540 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 13–31 | 5,400 | 3,130 | 3,715 | 140,000 | 0.274 | 0.194 |
| April | 4,300 | 2,740 | 3,343 | 198,900 | .247 | .276 |
| May | 6,500 | 1,930 | 3,031 | 186,400 | .224 | .258 |
| June | 20,000 | 2,150 | 4,364 | 259,700 | .322 | .359 |
| July | 11,750 | 2,150 | 4,266 | 262,300 | .315 | .363 |
| August | 3,890 | 1,660 | 2,380 | 146,300 | .176 | .203 |
| September | 4,960 | 1,660 | 2,392 | 142,300 | .177 | .198 |
| October | 9,750 | 1,660 | 2,941 | 180,800 | .217 | .250 |
| November 1–26 | 2,500 | 1,510 | 1,961 | 101,100 | .145 | .140 |
| The period | | | | 1,618,000 | | |

NOTE.—The measurements made in 1904 were not sufficiently well distributed to make the above monthly estimate other than a rough approximation.

## MISCELLANEOUS MEASUREMENTS IN THE PLATTE RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Platte River drainage basin in Nebraska, in 1904:

*Miscellaneous measurements in the Platte River drainage basin in 1904.*

| Date. | Hydrographer. | Stream. | Locality. | Area. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | | *Sq. feet.* | *Ft. per sec.* | *Sec.-feet* |
| August 31 | H. O. Smith | Blue Creek | Sec. 18, T. 16, R. 42 | | | 48 |
| June 22 | R. D. Hubbard | Calf Creek | Sec. 5, T. 25, R. 26 | | | 1 |
| September 15 | do | Dismal River | Dunning, Nebr. | | | 395 |
| May 26 | J. C. Stevens | Elkhorn River | Arlington, Nebr | 523 | 2.57 | 1,343 |
| May 26 | do | do | do | 526 | 2.44 | 1,284 |
| September 13 | R. D. Hubbard | Goose Creek | Sec. 18, T. 25, R. 24 | | | 14.4 |
| June 10 | R. H. Willis | Glenwood Creek | Sec. 15, T. 18, R. 50 | | | 6 |
| April 27 | H. O. Smith | Lodgepole River | Sec. 8, T. 14, R. 51 | | | 8.6 |
| April 27 | do | do | Sec. 9, T. 14, R. 51 | | | 7.6 |
| April 27 | do | do | Sec. 10, T. 14, R. 51 | | | 7.2 |
| April 28 | do | do | Sec. 33, T. 15, R. 56 | | | 14.4 |
| April 30 | do | do | Sec. 31, T. 15, R. 56 | | | 12.4 |
| May 2 | do | do | State line, Colo.-Nebr. | | | 4.3 |
| May 2 | do | do | 1 mi. E. State line | | | 4.6 |
| May 3 | do | do | Sec. 8, T. 14, R. 58 | | | 34.7 |
| May 4 | do | do | Sec. 29, T. 15, R. 55 | | | 20.5 |
| May 5 | do | do | Sec. 33, T. 15, R. 56 | | | 48.2 |
| June 15 | do | do | Kimball, Nebr. | | | 2.1 |

*Miscellaneous measurements in the Platte River drainage basin in 1904*—Continued.

| Date. | Hydrographer. | Stream. | Locality. | Area. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | | *Sq. feet.* | *Ft. per sec.* | *Sec.-feet.* |
| September 6 | H. O. Smith | Lodgepole River | Kimball, Nebr. | | | 13.4 |
| September 8 | do | do | 3 mi. W. Kimball, Nebr. | | | 8.7 |
| September 8 | do | do | Sec. 31, T. 14, R. 46 | | | 3.3 |
| May 24 | R. D. Hubbard | Middle Loup River. | Seneca, Nebr. | 82 | 2.50 | 205 |
| May 24 | do | do | Thedford, Nebr | 92 | 2.95 | 271 |
| June 10 | do | do | Arcadia, Nebr. | 365 | 3.40 | 2,162 |
| June 10 | do | do | St. Paul, Nebr. | 2,079 | 6.16 | [a]12,800 |
| June 22 | J. A. Green | do | Thedford, Nebr | 90 | 2.58 | 232 |
| October 11 | Adna Dobson | do | Sec. 32, T. 19, R. 21, Nebr. | | | 878 |
| June 10 | R. D. Hubbard | North Loup River | St. Paul, Nebr | 827 | 2.68 | 2,219 |
| June 20 | do | do | Brownlee, Nebr | 55 | 2.67 | 147 |
| June 20 | do | do | do | 57 | 2.81 | 160 |
| June 21 | J. A. Green | do | Cascade, Nebr. | 89 | 2.55 | 227 |
| September 14 | R. D. Hubbard | do | Brewster, Nebr. | | | 467 |
| July 26 | J. A. Green | South Loup River | Callaway, Nebr | | | 82 |
| July 27 | do | do | Sec. 27, T. 18, R. 26 | | | 9 |
| July 28 | do | do | Sec. 31, T. 17, R. 24 | | | 56 |
| July 28 | do | do | Sec. 30, T. 15, R. 21 | | | 103 |
| July 25 | do | Mud Creek | Litchfield, Nebr. | | | 37 |
| May 7 | J. C. Stevens | Platte River | Valley, Nebr | 1,580 | 2.51 | 3,976 |
| August 28 | R. D. Hubbard | do | Grand Island, Nebr. | | | Dry. |
| September 13 | H. O. Smith | do | Sec. 29, T. 12, R. 26 | | | 36 |
| August 27 | do | North Platte River | Southerland, Nebr. | | | 27 |
| August 28 | do | do | Sec. 18, T. 14, R. 36 | | | 30 |
| August 30 | do | do | Lewellen, Nebr | | | 60 |
| March 26 | J. C. Stevens | South Platte River | North Platte, Nebr | | | Dry. |
| April 17 | Adna Dobson | do | Ogalalla, Nebr | | | Dry. |
| May 27 | J. C. Stevens | do | Julesburg, Nebr | | | 130 |
| May 27 | R. D. Hubbard | do | North Platte, Nebr. | | | 11 |
| June 13 | J. C. Stevens | do | do | 906 | 2.46 | 2,231 |
| June 16 | H. O. Smith | Pumpkin Seed Creek | Sec. 33, T. 19, R. 52 | | | 11.4 |
| April 30 | R. D. Hubbard | Spotted Tail Creek | Sec. 2, T. 23, R. 56 | | | 1 |
| October 11 | Adna Dobson | Victoria Creek | Sec. 1, T. 19, R. 21 | | | 2.6 |

[a] Flood measurement gage height 3.60.

## KANSAS RIVER DRAINAGE BASIN.

The drainage basin of Kansas River lies between those of the Platte and Arkansas rivers, being entirely within the region of the Great Plains and principally within the arid or semiarid area. It has no mountain tributaries, but depends entirely for its water supply upon the water which, falling within or near the basin, percolates slowly to the drainage channels. The catchment area extends from eastern Colorado to Missouri River, a distance from east to west of 485 miles. Its extreme width is about 200 miles. The main stream of Kansas River is formed at Junction, Kans., by Republican and Smoky Hill

rivers and flows east into the Missouri at Kansas City. The Republican, its principal tributary, drains southern Nebraska and northern Kansas by means of many small tributary creeks. Solomon, Saline, and Smoky Hill rivers drain the plains of northwestern Kansas. Blue River is a tributary in northeastern Kansas, flowing south into Kansas River near Manhattan, Kans.

### KANSAS RIVER NEAR ST. GEORGE, KANS.

This station was established as a flood station April 13, 1904, by M. C. Hinderlider. It is located at the highway bridge one-fourth mile east of St. George, and opposite the Union Pacific Railroad tracks. A plain, vertical gage is painted on the north face of the upstream tube of the first pier from the left end of the bridge. It is graduated to feet and tenths from 10 to 26 feet. During 1904 the gage was read once daily, or oftener during sudden changes in the stage of the river, by G. A. Parr, station agent for the Union Pacific Railroad. Discharge measurements are made from the downstream side of the bridge, to which the gage is attached. The initial point for soundings is the foot of the north abutment on the downstream side. The current is straight for about half a mile above and below the station, and the current is medium to swift. Both banks overflow for some distance back from the main stream. The bed of the stream is composed principally of shale, with a sand deposit in places, and is permanent on the left side of the river, but unstable on the right or south side. Bench mark No. 1 is a United States Geological Survey standard bench-mark tablet set in the southwest corner of the north masonry abutment of the bridge, on the top surface of the bridge seat. Its elevation is 26.268 feet above the datum of the gage, and 993.39 feet above sea level. Bench mark No. 2 is a United States Coast and Geodetic Survey bench mark on the window sill of Johnston's store in St. George, Kans. Its elevation is 37.571 feet above the datum of the gage, and 1,004.69 feet above sea level. This station has been abandoned.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Gage heights, in feet, of Kansas River near St. George, Kans., for 1904.*

| Date. | A. M. | G. H. | P. M. | G. H. | Date. | A. M. | G. H. | P. M. | G. H. |
|---|---|---|---|---|---|---|---|---|---|
| | | *Feet.* | | *Feet.* | | | *Feet.* | | *Feet.* |
| April 25 | ..... | ..... | 6.30 | 10.1 | June 26 | 10.00 | 17.6 | 7.00 | 17.3 |
| April 26 | 6.30 | 12.6 | 3.00 | 14.3 | June 27 | 7.00 | 16.2 | ..... | ..... |
| | 11.00 | 13.8 | 7.30 | 14.3 | June 28 | 7.00 | 14.4 | ..... | ..... |
| April 27 | 6.30 | 13.6 | 7.00 | 12.8 | June 29 | 7.00 | 12.6 | 7.00 | 12.3 |
| May 9 | ..... | ..... | 7.00 | 10.0 | June 30 | 7.00 | 13.3 | ..... | ..... |
| May 10 | 7.00 | 10.4 | 7.00 | 10.5 | | 12.00 | 14.3 | 7.00 | 14.0 |
| May 11 | 7.00 | 10.0 | ..... | ..... | July 1 | 7.00 | 13.6 | 7.00 | 12.3 |
| May 29 | 7.00 | 10.0 | 3.00 | 13.8 | July 2 | 7.00 | 11.6 | ..... | ..... |
| | 10.30 | 12.1 | 6.00 | 14.3 | July 4 | ..... | ..... | 7.00 | 10.0 |
| | 12.00 | 13.0 | ..... | ..... | July 5 | 7.00 | 11.3 | 7.00 | 12.4 |
| May 30 | 7.00 | 12.6 | 7.00 | 12.0 | July 6 | 6.00 | 16.6 | ..... | ..... |
| May 31 | 7.00 | 11.7 | 7.00 | 11.2 | | 9.00 | 17.6 | 3.00 | 19.0 |
| June 1 | 7.00 | 11.0 | 7.00 | 11.6 | | 12.00 | 18.3 | 7.00 | 19.6 |
| June 2 | 7.00 | 11.8 | 7.00 | 10.9 | July 7 | 7.00 | 18.6 | ..... | ..... |
| June 3 | 7.00 | 11.0 | 7.00 | 12.8 | | 10.00 | 18.0 | 3.00 | 17.6 |
| | 12.00 | 12.0 | ..... | ..... | | 12.00 | 17.6 | 7.00 | 17.9 |
| June 4 | 7.00 | 11.7 | 7.00 | 13.0 | July 8 | 7.00 | 17.8 | ..... | ..... |
| June 5 | 7.00 | 13.4 | 7.00 | 13.0 | | 10.00 | 17.6 | 3.00 | 17.3 |
| | 12.00 | 13.2 | ..... | ..... | | 12.00 | 17.4 | 7.00 | 17.1 |
| June 6 | 7.00 | 12.3 | 7.00 | 11.6 | July 9 | 7.00 | 17.1 | ..... | ..... |
| June 7 | 7.00 | 10.9 | 7.00 | 10.3 | | 10.00 | 17.1 | 3.00 | 16.6 |
| June 11 | 7.00 | 10.6 | 7.00 | 11.0 | | 12.00 | 16.9 | 7.00 | 16.2 |
| June 15 | ..... | ..... | 7.00 | 10.6 | July 10 | 7.00 | 15.5 | ..... | ..... |
| June 16 | 7.00 | 11.1 | 7.00 | 11.8 | | 10.00 | 15.2 | 7.00 | 15.1 |
| | 12.00 | 11.8 | ..... | ..... | July 11 | 7.00 | 15.0 | 7.00 | 15.0 |
| June 17 | 7.00 | 11.6 | 7.00 | 10.8 | July 12 | 7.00 | 14.7 | 7.00 | 14.8 |
| June 24 | ..... | ..... | 7.00 | 10.0 | July 13 | 7.00 | 15.0 | 7.00 | 14.7 |
| June 25 | 7.00 | 12.4 | 3.00 | 17.0 | July 14 | 7.00 | 14.2 | ..... | ..... |
| | 10.00 | 15.0 | 7.00 | 17.6 | July 15 | 7.00 | 13.6 | ..... | ..... |
| | 12.00 | 16.0 | ..... | ..... | July 16 | 7.00 | 12.0 | ..... | ..... |
| June 26 | 7.00 | 17.6 | 3.00 | 17.5 | | | | | |

## KANSAS RIVER AT CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD BRIDGE, TOPEKA, KANS.

This station was established as a flood station April 14, 1904, by M. C. Hinderlider. It is located at the Chicago, Rock Island and Pacific Railroad bridge, about 2,100 feet above the Melan Arch Bridge, and 4,500 feet above the Atchison, Topeka and Santa Fe Railway bridge at Topeka, Kans. A plain gage, graduated to feet and tenths, is painted on the south face of the first pier from the left end of the bridge. The gage reads from 5 to 23 feet, the 10-foot mark being about 5 feet above mean low water. During 1904 the gage was read once daily, or oftener during sudden changes in the stage of the river, by E. M. Mathers, station agent for the Chicago, Rock Island and Pacific Railroad. Discharge measurements are made from the downstream side of the five-span bridge to which the gage is attached. The initial point for soundings is the north face of the right abutment. The channel is straight for about 1 mile above and below the station. The current is moderate at ordinary and swift at high stages. The right bank

is a 15-foot bluff, having a slope of about 45°, and composed principally of loam lined with loose riprap of stone. The left bank is not as high as the right bank and below the station leads on to a gravel bar which extends out for about 500 feet. Both banks are subject to overflow. The bed of the stream is composed of sand and silt, but is fairly permanent. The water flows in one channel at all ordinary stages broken by four concrete piers, and at very high water spreads out over North and South Topeka for distances varying from one-fourth to 1 mile out from the river channel. Bench mark No. 1 is a cross on the southwest corner of the left abutment, and is marked "U. S. G. S. B. M., El. 883.822." Its elevation is 23.635 feet above the datum of the gage. This station has been abandoned.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurement of Kansas River at Chicago, Rock Island and Pacific Railroad bridge, Topeka, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 6 | M. C. Hinderlider | 820 | 4,616 | 5.09 | 11.95 | 23,480 |

*Mean daily gage height, in feet, of Kansas River at Chicago, Rock Island and Pacific Railroad bridge, Topeka, Kans., for 1904.*

| Day. | Apr. | May. | June. | July. | Aug. | Day. | Apr. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 8.18 | 10.65 | 13.20 | 6.40 | 17 | ..... | 9.20 | 11.10 | 11.40 | 5.70 |
| 2 | ..... | 7.35 | 11.60 | 11.70 | 6.40 | 18 | ..... | 8.60 | 10.30 | 10.70 | 5.60 |
| 3 | ..... | 6.85 | 12.20 | 10.30 | 6.20 | 19 | ..... | 7.92 | ..... | 9.70 | 5.70 |
| 4 | ..... | 6.70 | 12.35 | 10.50 | 6.20 | 20 | ..... | 7.55 | ..... | 8.60 | 5.80 |
| 5 | ..... | 6.70 | 12.75 | 10.50 | 6.10 | 21 | ..... | 7.00 | ..... | 8.00 | ..... |
| 6 | ..... | 6.60 | 12.35 | 17.30 | 6.00 | 22 | ..... | 6.75 | ..... | 9.80 | 5.80 |
| 7 | ..... | 6.60 | 10.60 | 22.05 | ..... | 23 | ..... | 6.45 | ..... | 8.40 | 6.00 |
| 8 | ..... | 7.55 | 10.05 | 19.40 | 6.00 | 24 | 10.20 | 6.30 | ..... | 8.20 | 5.90 |
| 9 | ..... | 7.90 | 9.25 | 18.60 | 6.00 | 25 | 10.42 | 6.20 | 12.05 | 8.10 | 5.80 |
| 10 | ..... | 9.15 | 10.00 | 17.20 | 6.00 | 26 | 10.62 | 6.40 | 16.85 | 7.70 | 5.80 |
| 11 | ..... | 9.25 | ..... | 16.35 | 6.00 | 27 | 13.22 | 7.05 | 15.70 | 7.40 | 5.80 |
| 12 | ..... | 8.30 | ..... | 14.00 | 5.80 | 28 | 12.10 | 6.62 | 14.10 | 7.40 | ..... |
| 13 | ..... | 8.25 | ..... | 13.75 | 5.70 | 29 | 11.60 | 12.35 | 12.70 | 6.90 | 5.50 |
| 14 | ..... | 8.28 | ..... | 13.70 | ..... | 30 | 9.80 | 17.55 | 11.70 | 6.70 | 5.20 |
| 15 | ..... | 7.70 | ..... | 12.80 | 5.70 | 31 | ..... | 12.38 | ..... | ..... | 5.20 |
| 16 | ..... | 8.60 | ..... | 12.10 | 5.70 | | | | | | |

## KANSAS RIVER AT ATCHISON, TOPEKA AND SANTA FE RAILWAY BRIDGE, TOPEKA, KANS.

This station was established as a flood station April 14, 1904, by M. C. Hinderlider. It is located at the Atchison, Topeka and Santa Fe Railroad bridge, 2,300 feet below the Melan Arch Bridge, and

4,500 feet below the Chicago, Rock Island and Pacific Railroad bridge, at Topeka, Kans. A plain vertical gage is painted on the south side of the third pier from the right abutment. The gage is graduated to feet and tenths from 10 to 23 feet, the 23-foot mark being at the top of the capstone and the 10-foot mark being about 5 feet above mean low water. During 1904 it was intended to have the gage read once a day or oftener during sudden rises in the stage of the river, but the observer failed to do this. Discharge measurements are made from the downstream side of the six-span bridge to which the gage is attached. The bridge has a trestle approach on the left end 316 feet long. The initial point for soundings is on the northeast corner of the right abutment. The channel is straight for 1 mile above and 1,000 feet below the station and the current is swift. The right bank is high and rocky, but is subject to overflow. The left bank is low, leading out to a sand and gravel bar extending out for about 1,000 feet. This was covered during the flood of 1903 and 1904 to a depth of from 3 to 8 feet. The bed of the stream is composed of sand and deposits of silt, and is unstable. The bench mark is a United States Coast and Geodetic Survey bench mark, designated as "N" in the records of the Geodetic Survey. It is on the northeast corner of the capstone of the right abutment of the bridge. Its elevation is 26.708 feet above the zero of the gage and 883.98 feet above mean sea level. The station has been abandoned.

### KANSAS RIVER[a] AT LECOMPTON, KANS.

The gaging station at Lecompton was established April 16, 1899, at the new wagon bridge. On June 24, 1900, a new gage was established, the old gage having been broken. Later, a pine board 1 inch by 6 inches by 10 feet long, graduated to feet and tenths, was spiked on top of the old gage, at the same elevation. November 5, 1904, a new gage was put in; this gage is in three sections. The first is a pine board graduated from zero to 3 feet and spiked to a pile 23 feet north of the initial point. The second section is painted on the downstream pier of the second set and graduated from 3 feet to 10 feet, and the third section is painted on the upstream pier of the first set and is graduated from 10 feet to 29.5 feet. On October 26, 1900, a bench mark was established on top of the bottom flange of the iron strut, connecting the two iron cylinders at the south end of the highway bridge over the river. The bench mark is at the west end of the strut, next to the cylinder. Its elevation is 12.19 feet above the zero of the gage. The observer is A. D. McAdow. The channel is somewhat curved at the bridge, and the bridge is slightly oblique to the direction of the current. The channel has a width of 800 feet, broken by four metal piers. The left bank is low and subject to overflow

[a] Also known as Kaw River.

during high water. The bed of the stream is sandy, with some rock, and changes slightly.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Kansas River at Lecompton, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Ft. per sec.* | *Feet.* | *Second-feet.* |
| March 18 | W. G. Russell | 695 | 1,513 | 2.25 | 3.10 | 3,532 |
| April 28 | do | 752 | 7,973 | 4.11 | 10.95 | 32,780 |
| May 31 | do | 774 | 8,174 | 4.61 | 11.50 | 37,730 |
| June 7 | do | 772 | 7,057 | 4.06 | 9.70 | 28,690 |
| July 10 | do | 808 | 12,660 | 4.48 | 14.25 | 56,660 |
| July 15 | do | 780 | 8,504 | 4.28 | 10.43 | 36,370 |
| November 5 | do | 603 | 1,652 | 2.47 | 2.80 | 4,078 |

*Mean daily gage height, in feet, of Kansas River at Lecompton, Kans., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.00 | 3.20 | 3.60 | 5.70 | 6.90 | 10.10 | 11.10 | 4.80 | 3.20 | 3.50 | 3.25 | 2.30 |
| 2 | 4.00 | 3.20 | 3.50 | 5.60 | 6.20 | 10.60 | 9.60 | 4.55 | 3.20 | 3.75 | 3.20 | 2.30 |
| 3 | 4.00 | 3.20 | 3.50 | 5.60 | 5.75 | 11.85 | 8.70 | 4.25 | 3.20 | 3.80 | 3.15 | 2.30 |
| 4 | 4.00 | 3.10 | 3.50 | 5.50 | 5.55 | 11.05 | 8.45 | 4.20 | 3.20 | 3.95 | 3.10 | 2.30 |
| 5 | 3.90 | 3.10 | 3.50 | 5.45 | 5.35 | 10.75 | 10.10 | 4.15 | 3.20 | 4.00 | 2.80 | 2.30 |
| 6 | 3.90 | 3.10 | 3.50 | 5.40 | 5.15 | 10.80 | 16.75 | 4.10 | 3.10 | 4.00 | 2.80 | 2.30 |
| 7 | 3.85 | 3.10 | 3.50 | 5.30 | 5.00 | 9.50 | 20.75 | 4.05 | 3.10 | 4.00 | 2.80 | 2.30 |
| 8 | 3.80 | 3.00 | 3.50 | 5.30 | 5.70 | 8.00 | 18.75 | 4.00 | 3.10 | 3.90 | 2.70 | 2.30 |
| 9 | 3.80 | 3.00 | 3.40 | 5.20 | 6.20 | 8.10 | 16.45 | 4.00 | 3.05 | 3.90 | 2.70 | 2.20 |
| 10 | 3.75 | 3.00 | 3.40 | 5.20 | 6.35 | 7.70 | 14.55 | 3.90 | 3.00 | 3.90 | 2.70 | 2.20 |
| 11 | 3.70 | 3.00 | 3.40 | 5.15 | 6.70 | 7.80 | 13.15 | 3.85 | 3.00 | 3.90 | 2.65 | 2.20 |
| 12 | 3.70 | 3.00 | 3.40 | 5.10 | 7.00 | 7.95 | 12.10 | 3.80 | 3.00 | 3.90 | 2.60 | 2.20 |
| 13 | 3.60 | 3.00 | 3.40 | 5.00 | 7.00 | 7.75 | 11.40 | 3.80 | 3.00 | 3.80 | 2.60 | 2.20 |
| 14 | 3.60 | 3.00 | 3.30 | 5.00 | 6.80 | 7.25 | 11.00 | 3.80 | 3.00 | 3.80 | 2.60 | 2.20 |
| 15 | 3.60 | 3.00 | 3.20 | 4.95 | 6.95 | 6.90 | 10.50 | 3.80 | 3.00 | 3.80 | 2.60 | 2.20 |
| 16 | 3.50 | 3.05 | 3.15 | 4.90 | 7.75 | 7.35 | 9.55 | 3.70 | 3.00 | 3.80 | 2.60 | 2.20 |
| 17 | 3.50 | 3.10 | 3.00 | 4.90 | 8.25 | 9.10 | 8.95 | 3.70 | 3.00 | 3.80 | 2.50 | 2.10 |
| 18 | 3.50 | 3.20 | 3.10 | 4.90 | 7.60 | 8.60 | 8.65 | 3.70 | 3.00 | 3.80 | 2.50 | 2.10 |
| 19 | 3.50 | 3.30 | 3.10 | 4.80 | 7.55 | 7.75 | 7.10 | 3.65 | 2.95 | 3.75 | 2.50 | 2.10 |
| 20 | 3.50 | 3.30 | 3.10 | 4.75 | 7.50 | 7.20 | 6.75 | 3.60 | 2.90 | 3.70 | 2.50 | 2.10 |
| 21 | 3.45 | 3.40 | 3.10 | 4.75 | 7.30 | 7.00 | 6.65 | 3.60 | 2.90 | 3.70 | 2.50 | 2.10 |
| 22 | 3.40 | 3.40 | 3.20 | 4.85 | 7.05 | 6.70 | 7.25 | 3.55 | 2.90 | 3.70 | 2.50 | 2.00 |
| 23 | 3.40 | 3.50 | 3.30 | 5.00 | 6.70 | 6.20 | 7.35 | 3.50 | 2.90 | 3.60 | 2.45 | 2.00 |
| 24 | 3.40 | 3.50 | 3.90 | 8.00 | 6.30 | 6.15 | 6.80 | 3.45 | 2.90 | 3.60 | 2.40 | 2.00 |
| 25 | 3.40 | 3.50 | 6.00 | 9.75 | 6.20 | 10.50 | 6.40 | 3.40 | 2.90 | 3.60 | 2.40 | 2.00 |
| 26 | 3.40 | 3.50 | 6.00 | 9.50 | 6.00 | 14.70 | 6.10 | 3.40 | 2.90 | 3.50 | 2.40 | 2.00 |
| 27 | 3.30 | 3.60 | 5.90 | 11.65 | 5.95 | 13.70 | 5.85 | 3.40 | 2.90 | 3.50 | 2.40 | 2.00 |
| 28 | 3.30 | 3.60 | 5.80 | 10.40 | 5.80 | 12.00 | 5.60 | 3.35 | 2.90 | 3.45 | 2.40 | 2.00 |
| 29 | 3.30 | 3.60 | 5.80 | 10.30 | 10.25 | 10.70 | 5.30 | 3.30 | 2.90 | 3.40 | 2.30 | 2.00 |
| 30 | 3.30 | ..... | 5.70 | 8.50 | 15.50 | 10.05 | 5.15 | 3.30 | 3.10 | 3.40 | 2.30 | 1.90 |
| 31 | 3.20 | ..... | 5.70 | ..... | 11.80 | ..... | 4.95 | 3.25 | ..... | 3.30 | ..... | 1.90 |

*Rating table for Kansas River at Lecompton, Kans., from January 1 to July 5, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.00 | 3,350 | 4.70 | 7,100 | 6.30 | 11,870 | 8.80 | 22,410 |
| 3.10 | 3,530 | 4.80 | 7,360 | 6.40 | 12,220 | 9.00 | 23,400 |
| 3.20 | 3,720 | 4.90 | 7,630 | 6.50 | 12,580 | 9.20 | 24,400 |
| 3.30 | 3,910 | 5.00 | 7,900 | 6.60 | 12,950 | 9.40 | 25,420 |
| 3.40 | 4,110 | 5.10 | 8,170 | 6.70 | 13,330 | 9.60 | 26,450 |
| 3.50 | 4,310 | 5.20 | 8,450 | 6.80 | 13,710 | 9.80 | 27,510 |
| 3.60 | 4,520 | 5.30 | 8,730 | 6.90 | 14,100 | 10.00 | 28,600 |
| 3.70 | 4,730 | 5.40 | 9,020 | 7.00 | 14,500 | 10.50 | 31,460 |
| 3.80 | 4,950 | 5.50 | 9,310 | 7.20 | 15,310 | 11.00 | 34,520 |
| 3.90 | 5,170 | 5.60 | 9,610 | 7.40 | 16,130 | 11.50 | 37,700 |
| 4.00 | 5,400 | 5.70 | 9,910 | 7.60 | 16,970 | 12.00 | 41,040 |
| 4.10 | 5,630 | 5.80 | 10,220 | 7.80 | 17,830 | 12.50 | 44,450 |
| 4.20 | 5,870 | 5.90 | 10,540 | 8.00 | 18,700 | 13.00 | 47,900 |
| 4.30 | 6,110 | 6.00 | 10,860 | 8.20 | 19,590 | 13.50 | 51,400 |
| 4.40 | 6,350 | 6.10 | 11,190 | 8.40 | 20,500 | 14.00 | 54,900 |
| 4.50 | 6,600 | 6.20 | 11,530 | 8.60 | 21,440 | 15.00 | 61,900 |
| 4.60 | 6,850 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is not well defined. On account of the shifting character of the stream bed it can only be considered a rough approximation.

*Rating table for Kansas River at Lecompton, Kans., from July 6 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.90 | 2,530 | 3.50 | 5,510 | 5.20 | 10,370 | 9.00 | 27,800 |
| 2.00 | 2,680 | 3.60 | 5,750 | 5.40 | 11,050 | 9.50 | 30,780 |
| 2.10 | 2,830 | 3.70 | 5,990 | 5.60 | 11,740 | 10.00 | 33,900 |
| 2.20 | 2,980 | 3.80 | 6,240 | 5.80 | 12,450 | 10.50 | 37,230 |
| 2.30 | 3,140 | 3.90 | 6,490 | 6.00 | 13,200 | 11.00 | 40,700 |
| 2.40 | 3,300 | 4.00 | 6,750 | 6.20 | 13,990 | 11.50 | 44,290 |
| 2.50 | 3,470 | 4.10 | 7,020 | 6.40 | 14,820 | 12.00 | 48,000 |
| 2.60 | 3,640 | 4.20 | 7,290 | 6.60 | 15,670 | 13.00 | 56,000 |
| 2.70 | 3,820 | 4.30 | 7,570 | 6.80 | 16,540 | 14.00 | 64,600 |
| 2.80 | 4,010 | 4.40 | 7,860 | 7.00 | 17,450 | 15.00 | 73,700 |
| 2.90 | 4,200 | 4.50 | 8,150 | 7.20 | 18,380 | 16.00 | 83,200 |
| 3.00 | 4,400 | 4.60 | 8,450 | 7.40 | 19,340 | 17.00 | 93,000 |
| 3.10 | 4,610 | 4.70 | 8,750 | 7.60 | 20,320 | 18.00 | 103,000 |
| 3.20 | 4,830 | 4.80 | 9,060 | 7.80 | 21,320 | 19.00 | 113,000 |
| 3.30 | 5,050 | 4.90 | 9,380 | 8.00 | 22,350 | 20.00 | 123,000 |
| 3.40 | 5,280 | 5.00 | 9,700 | 8.50 | 24,990 | 21.00 | 133,000 |

The above table is applicable only for open-channel conditions. It is based upon 2 discharge measurements made during 1904, and upon the general form of the curves for 1903 and the first part of 1904. It is not well defined. (See note to preceding table.)

*Estimated monthly discharge of Kansas River at Lecompton, Kans., for 1904.*[a]

[Drainage area, 58,550 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 5,400 | 3,720 | 4,520 | 277,900 | 0.077 | 0.089 |
| February | 4,520 | 3,350 | 3,783 | 217,600 | .065 | .070 |
| March | 10,860 | 3,350 | 5,464 | 336,000 | .093 | .107 |
| April | 38,350 | 7,360 | 12,900 | 767,600 | .220 | .246 |
| May | 65,400 | 7,900 | 16,020 | 985,000 | .274 | .316 |
| June | 59,800 | 11,530 | 25,290 | 1,505,000 | .432 | .482 |
| July | 130,000 | 9,700 | 36,190 | 2,225,000 | .618 | .712 |
| August | 9,060 | 4,830 | 6,198 | 381,100 | .106 | .122 |
| September | 4,830 | 4,200 | 4,433 | 263,800 | .076 | .085 |
| October | 6,750 | 5,050 | 6,073 | 373,400 | .104 | .120 |
| November | 4,830 | 3,140 | 3,704 | 220,400 | .063 | .070 |
| December | 3,140 | 2,530 | 2,891 | 177,800 | .049 | .056 |
| The year | 130,000 | 2,530 | 10,620 | 7,731,000 | .181 | 2.48 |

[a] The above monthly estimates are only very rough approximations.

## REPUBLICAN RIVER AT BENKELMAN, NEBR.

This station was established May 20, 1903, by J. C. Stevens. It is located at a highway bridge between secs. 17 and 20, T. 1 N., R. 37 W., and about one-half mile east of Benkelman, Nebr., which is on the main line of the Burlington and Missouri River Railroad. The gage is a vertical 2 by 4 inch rod 6 feet long, spiked to the downstream side of the second bent from the west end of the bridge. It is read once each day by Leon L. Hines. Discharge measurements are made from the upstream side of the highway bridge, the upstream hand rail of which is marked at 5-foot intervals by notches cut into the rail. This bridge is one-fourth mile above the mouth of the South Fork of Republican River. The initial point for soundings is the zero mark on the upstream hand rail at the east end of the bridge. The channel is straight for 200 feet above and 500 feet below the station. Both banks are low and sandy, free from timber, and liable to overflow at very high stages. The bed is composed of shifting sand, and there is but one channel, except at extreme low water. The river sometimes goes dry during the summer. Bench mark No. 1 is the top of the south end of the concrete foundation for the first or west upright bent of the elevated track in the Burlington and Missouri River Railroad yards just east of the railroad station. To this bench mark the gage rods of both the Republican and South Fork of the Republican stations were referred. Its elevation above the zero of the Republican River gage is 16.14 feet. Bench marks Nos. 2, 3, 4, and 5 are, respectively, the tops of the south ends of the caps of the first, second, third, and fourth bents from the west end of the Republican River bridge. Their elevations above the zero of the Republican River gage are 6.88, 6.74, 6.34, and 6.19 feet, respectively.

A station was maintained on this stream from November 1, 1894, to September 7, 1895, the gagings being made several miles farther upstream. A description of this station and the results of the observations are given on page 125 of bulletin No. 140.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of Republican River at Benkelman, Nebr., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| April 3 | J. C. Stevens | 125 | 72 | 1.55 | 1.10 | 112 |
| April 18 | Adna Dobson | | | | 1.02 | 32 |
| June 16 | J. C. Stevens | 149 | 47 | 1.85 | 1.10 | 87 |
| December 7 | J. A. Green | | | | 1.50 | 136 |

*Mean daily gage height, in feet, of Republican River at Benkelman, Nebr., for 1904.*

| Day. | Jan.[a] | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.30 | ..... | 1.00 | 1.10 | 1.25 | 1.00 | 1.10 | 1.60 | 0.80 | 1.15 | 1.20 | 1.20 |
| 2 | 1.40 | ..... | .95 | 1.10 | 1.30 | 1.10 | 1.15 | 1.40 | .70 | 1.15 | 1.20 | 1.30 |
| 3 | 1.35 | ..... | 1.10 | 1.10 | 1.10 | 1.25 | 1.10 | 1.00 | .80 | 1.30 | 1.20 | 1.20 |
| 4 | 1.30 | ..... | .90 | 1.10 | 1.25 | 1.60 | 1.20 | 1.20 | .70 | 1.70 | 1.20 | (c) |
| 5 | 1.30 | ..... | .90 | 1.10 | 1.20 | 1.05 | 1.10 | 1.10 | .70 | 1.00 | 1.20 | ..... |
| 6 | 1.40 | ..... | 1.05 | 1.10 | 1.20 | 1.10 | 1.05 | ..... | .75 | 1.00 | 1.20 | ..... |
| 7 | 1.50 | ..... | .90 | 1.20 | 1.20 | 1.00 | 1.75 | ..... | .80 | 1.00 | 1.20 | 1.50 |
| 8 | 1.60 | ..... | .95 | ..... | 1.00 | 1.00 | ..... | 1.10 | .90 | 1.00 | 1.15 | ..... |
| 9 | 1.60 | ..... | 1.10 | 1.10 | 1.00 | 1.10 | 1.25 | 1.05 | .90 | 1.00 | ..... | ..... |
| 10 | 1.60 | ..... | 1.05 | 1.05 | 1.05 | 1.40 | 1.20 | 1.00 | .90 | 1.10 | 1.15 | ..... |
| 11 | 1.50 | ..... | 1.00 | 1.10 | 1.00 | 1.20 | 1.10 | .90 | .90 | 1.10 | 1.15 | ..... |
| 12 | 1.45 | ..... | 1.00 | 1.00 | .95 | 1.20 | 1.00 | 1.10 | .85 | 1.00 | 1.15 | ..... |
| 13 | 1.30 | ..... | 1.05 | 1.00 | .90 | 1.40 | 1.00 | .80 | .85 | 1.05 | 1.20 | ..... |
| 14 | 1.45 | ..... | 1.00 | 1.00 | .90 | 1.20 | .90 | .80 | .85 | 1.00 | 1.15 | ..... |
| 15 | 1.55 | ..... | 1.10 | 1.00 | 1.05 | 1.20 | 1.00 | .80 | .80 | 1.05 | 1.25 | ..... |
| 16 | 1.45 | ..... | 1.00 | 1.05 | 1.00 | 1.10 | .90 | .80 | ..... | 1.00 | 1.15 | ..... |
| 17 | 1.45 | ..... | 1.00 | 1.00 | 1.00 | 1.35 | .85 | .80 | .90 | 1.05 | 1.20 | ..... |
| 18 | 1.45 | ..... | .80 | 1.00 | 1.00 | 1.35 | .80 | .80 | .85 | ..... | 1.15 | ..... |
| 19 | 1.30 | ..... | .95 | 1.00 | 1.00 | 1.10 | .90 | .90 | .85 | 1.60 | 1.15 | ..... |
| 20 | 1.30 | ..... | 1.00 | 1.00 | 1.00 | 1.00 | 1.20 | .90 | .85 | 1.30 | 1.20 | ..... |
| 21 | .90 | ..... | 1.05 | 1.00 | 1.05 | 1.10 | 1.00 | ..... | .85 | 1.30 | 1.15 | ..... |
| 22 | .90 | ..... | 1.00 | 1.05 | 1.10 | 1.15 | 1.00 | .90 | .85 | 1.20 | 1.20 | ..... |
| 23 | 1.00 | ..... | 1.05 | 1.00 | 1.20 | 1.25 | .90 | .85 | .85 | 1.20 | 1.30 | ..... |
| 24 | (b) | ..... | 1.05 | ..... | 1.00 | 1.80 | 1.10 | .80 | .85 | 1.15 | 1.20 | ..... |
| 25 | ..... | ..... | 1.05 | 1.20 | 1.00 | 1.20 | .90 | .80 | .90 | 1.20 | 1.15 | ..... |
| 26 | ..... | ..... | 1.00 | 1.20 | 1.00 | 1.15 | .80 | .80 | .90 | 1.10 | 1.20 | ..... |
| 27 | ..... | (b) | 1.05 | 1.10 | 1.05 | 1.15 | .80 | .80 | .90 | 1.20 | 1.25 | ..... |
| 28 | ..... | 0.95 | 1.00 | 1.05 | 1.10 | 1.10 | .80 | .80 | ..... | 1.20 | ..... | ..... |
| 29 | ..... | .95 | 1.05 | 1.00 | 1.00 | 1.15 | .80 | .80 | 1.10 | 1.20 | ..... | ..... |
| 30 | ..... | ..... | 1.10 | 1.30 | 1.00 | 1.15 | .75 | .80 | 1.10 | 1.20 | 1.30 | ..... |
| 31 | ..... | ..... | 1.10 | ..... | 1.00 | ..... | .75 | .80 | ..... | 1.20 | ..... | ..... |

[a] River frozen during January.
[b] No gage-height observations January 24 to February 27, inclusive.
[c] Ice.

*Mean daily discharge, in second-feet, of Republican River at Benkelman, Nebr., for 1904.*[a]

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 87 | 111 | 87 | 55 | 46 | 165 | 10 | 55 | 65 | 65 |
| 2 | ..... | 76 | 111 | 99 | 76 | 55 | 111 | 0 | 55 | 65 | 87 |
| 3 | ..... | 111 | 111 | 55 | 111 | 46 | 30 | 10 | 87 | 65 | 65 |
| 4 | ..... | 65 | 111 | 87 | 211 | 65 | 65 | 0 | 195 | 65 | ..... |
| 5 | ..... | 65 | 111 | 76 | 65 | 46 | 46 | 0 | 30 | 65 | ..... |
| 6 | ..... | 99 | 111 | 76 | 76 | 38 | 46 | 5 | 30 | 65 | ..... |
| 7 | ..... | 65 | 124 | 76 | 55 | 211 | 46 | 10 | 30 | 65 | 136 |
| 8 | ..... | 76 | 105 | 38 | 55 | 143 | 46 | 17 | 30 | 55 | ..... |
| 9 | ..... | 111 | 87 | 38 | 76 | 76 | 38 | 17 | 30 | 55 | ..... |
| 10 | ..... | 99 | 76 | 46 | 151 | 65 | 30 | 17 | 46 | 55 | ..... |
| 11 | ..... | 87 | 87 | 38 | 99 | 46 | 17 | 17 | 46 | 55 | ..... |
| 12 | ..... | 87 | 46 | 30 | 99 | 30 | 46 | 13 | 30 | 55 | ..... |
| 13 | ..... | 99 | 46 | 23 | 151 | 30 | 10 | 13 | 38 | 65 | ..... |
| 14 | ..... | 87 | 38 | 23 | 99 | 17 | 10 | 13 | 30 | 55 | ..... |
| 15 | ..... | 111 | 38 | 46 | 99 | 30 | 10 | 10 | 38 | 76 | ..... |
| 16 | ..... | 87 | 38 | 46 | 87 | 17 | 10 | 14 | 30 | 55 | ..... |
| 17 | ..... | 87 | 30 | 46 | 137 | 13 | 10 | 17 | 38 | 65 | ..... |
| 18 | ..... | 46 | 30 | 46 | 137 | 10 | 10 | 13 | 101 | 55 | ..... |
| 19 | ..... | 76 | 30 | 46 | 65 | 17 | 17 | 13 | 165 | 55 | ..... |
| 20 | ..... | 87 | 30 | 46 | 46 | 65 | 17 | 13 | 87 | 65 | ..... |
| 21 | ..... | 99 | 30 | 55 | 65 | 30 | 17 | 13 | 87 | 55 | ..... |
| 22 | ..... | 87 | 38 | 65 | 76 | 30 | 17 | 13 | 65 | 65 | ..... |
| 23 | ..... | 99 | 30 | 87 | 87 | 17 | 13 | 13 | 65 | 87 | ..... |
| 24 | ..... | 99 | 47 | 46 | 227 | 46 | 10 | 13 | 55 | 65 | ..... |
| 25 | ..... | 99 | 65 | 46 | 65 | 17 | 10 | 17 | 65 | 55 | ..... |
| 26 | ..... | 65 | 65 | 46 | 55 | 10 | 10 | 17 | 46 | 65 | ..... |
| 27 | ..... | 99 | 46 | 55 | 55 | 10 | 10 | 17 | 65 | 76 | ..... |
| 28 | 76 | 87 | 38 | 65 | 46 | 10 | 10 | 31 | 65 | 80 | ..... |
| 29 | 76 | 99 | 30 | 46 | 55 | 10 | 10 | 46 | 65 | 83 | ..... |
| 30 | ..... | 111 | 87 | 46 | 55 | 5 | 10 | 46 | 65 | 87 | ..... |
| 31 | ..... | 111 | ..... | 46 | ..... | 5 | 10 | ..... | 65 | ..... | ..... |

[a] The daily discharge was obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq. Discharge interpolated for days when the gage was not observed.

*Estimated monthly discharge of Republican River at Benkelman, Nebr., for 1904.*

[Drainage area, 3,965 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March | 111 | 46 | 89.1 | 5,478 | 0.022 | 0.025 |
| April | 124 | 30 | 64.9 | 3,862 | .016 | .018 |
| May | 99 | 23 | 53.9 | 3,314 | .014 | .016 |
| June | 227 | 46 | 91.2 | 5,427 | .023 | .026 |
| July | 211 | 5 | 40.5 | 2,490 | .010 | .012 |
| August | 165 | 10 | 29.3 | 1,802 | .0074 | .0085 |
| September | 46 | 0 | 14.9 | 887 | .0038 | .0042 |
| October | 195 | 30 | 61.3 | 3,769 | .015 | .017 |
| November | 87 | 55 | 64.6 | 3,844 | .016 | .018 |
| The period | | | | 30,870 | | |

NOTE.—Insufficient measurements were made during 1904 to make the above monthly estimates other than a rough approximation.

## REPUBLICAN RIVER (SOUTH FORK) NEAR BENKELMAN, NEBR.

This station was established May 20, 1903, by J. C. Stevens. It is located at a highway bridge between secs. 17 and 20, T. 1 N., R. 37 W., and about three-fourths of a mile east of Benkelman, Nebr. The South Fork empties into Republican River about one-fourth of a mile below this station. A station is also maintained on Republican River one-fourth of a mile above the junction of the two streams. The gage is a vertical 2 by 4 inch rod 5½ feet long, spiked to the upstream side of the first bent in the channel from the east bank of the stream. It is read once each day by Leon L. Hines. Discharge measurements are made from the upstream side of the highway bridge to which the gage is attached. The upstream hand rail of this bridge is marked at 5-foot intervals by notches cut into the rail, and the initial point for soundings is the zero mark on the rail at the east end of the bridge. The channel is straight for 1,000 feet above and 500 feet below the station. Both banks are low and sandy, free from timber, and liable to overflow at very high stages. The bed of the stream is sandy and shifting, and there is but one channel except at extremely low stages. The river usually goes dry during the summer. Bench mark No. 1 is the top of the south end of the concrete foundation for the first or west upright bent of the elevated track in the Burlington and Missouri River Railroad yards just east of the station. Its eleva-

tion above the zero of the South Fork gage is 18.29 feet. This is also bench mark No. 1 of the Republican River gage. Bench marks Nos. 2, 3, 4, and 5 are, respectively, the tops of the south ends of the first, second, third, and fourth bents from the west end of the South Fork bridge. Their elevations above the zero of the South Fork gage are 6.62, 6.48, 6.38, and 6.20 feet, respectively.

A station was maintained on this river from November 1, 1894, to September 7, 1895, the gagings being made near the present station. A description of the old station and the results of the observations are given on page 130 of Bulletin No. 140.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of Republican River (South Fork) near Benkelman, Nebr., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| April 3 | J. C. Stevens | 65 | 24 | 1.32 | 1.20 | 32 |
| April 18 | Adna Dobson | 106 | 76 | 1.87 | 1.70 | 142 |
| June 16 | J. C. Stevens | 106 | 77 | 1.88 | 1.70 | 145 |
| June 16 | do | | | | 1.10 | 14 |
| December 7 | J. A. Green | | | | 1.32 | 32 |

*Mean daily gage height, in feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904.*

| Day. | Jan.[a] | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.30 | ..... | 1.35 | 1.20 | 1.50 | 1.50 | 1.35 | 1.00 | 1.05 | 1.30 | 1.50 | 1.30 |
| 2 | 1.50 | ..... | 1.40 | 1.15 | 1.55 | 1.55 | 1.40 | 1.50 | 1.05 | 1.25 | 1.50 | 1.30 |
| 3 | 1.40 | ..... | 1.30 | 1.20 | 1.50 | 1.60 | 1.50 | 1.00 | 1.05 | 1.25 | 1.50 | 1.30 |
| 4 | 1.30 | ..... | 1.40 | 1.20 | 1.50 | 1.40 | 1.55 | 1.20 | 1.00 | 1.30 | 1.50 | (c) |
| 5 | 1.30 | ..... | 1.55 | 1.20 | 1.70 | 1.60 | 1.40 | 1.10 | 1.00 | 1.30 | 1.50 | ..... |
| 6 | 1.40 | ..... | 1.50 | 1.20 | 1.50 | 1.55 | 1.50 | ..... | 1.00 | 1.25 | 1.50 | ..... |
| 7 | 1.40 | ..... | 1.35 | 1.00 | 1.50 | 1.50 | 1.30 | ..... | 1.00 | 1.30 | 1.50 | 1.32 |
| 8 | 1.40 | ..... | 1.40 | ..... | 1.50 | 1.45 | ..... | 1.00 | 1.00 | 1.40 | 1.45 | ..... |
| 9 | 1.40 | ..... | 1.40 | 1.00 | 1.40 | 1.60 | 1.60 | 1.50 | 1.00 | 1.30 | ..... | ..... |
| 10 | 1.40 | ..... | 1.40 | 1.05 | 1.45 | 1.75 | 1.55 | 1.40 | 1.00 | 1.40 | 1.40 | ..... |
| 11 | 1.55 | ..... | 1.30 | 1.10 | 1.40 | 2.15 | 1.50 | 1.30 | 1.00 | 1.40 | 1.50 | ..... |
| 12 | 1.60 | ..... | 1.40 | 1.10 | 1.35 | 1.80 | 1.20 | 1.10 | 1.00 | 1.30 | 1.50 | ..... |
| 13 | 1.40 | ..... | 1.40 | 1.15 | 1.40 | 1.80 | 1.30 | 1.10 | 1.00 | 1.30 | 1.50 | ..... |
| 14 | 1.30 | ..... | 1.40 | 1.00 | 1.40 | 1.80 | 1.30 | 1.10 | 1.00 | 1.25 | 1.50 | ..... |
| 15 | 1.40 | ..... | 1.40 | .95 | 1.40 | 1.80 | 1.10 | 1.10 | 1.00 | 1.25 | 1.45 | ..... |
| 16 | 1.40 | ..... | 1.40 | 1.00 | 1.40 | 1.60 | 1.10 | 1.10 | ..... | 1.25 | 1.45 | ..... |
| 17 | 1.45 | ..... | 1.40 | .95 | 1.40 | 1.80 | 1.05 | 1.05 | 1.00 | 1.30 | 1.50 | ..... |
| 18 | 1.50 | ..... | 1.40 | .90 | 1.40 | 1.80 | 1.00 | 1.10 | .85 | ..... | 1.45 | ..... |
| 19 | 1.40 | ..... | 1.40 | .95 | 1.40 | 2.30 | 1.05 | 1.10 | .85 | 1.70 | 1.45 | ..... |
| 20 | 1.50 | ..... | 1.40 | .95 | 1.30 | 1.30 | 1.10 | 1.00 | .85 | 1.70 | 1.45 | ..... |
| 21 | 1.40 | ..... | 1.40 | .95 | 1.40 | 1.50 | .90 | ..... | .85 | 1.60 | 1.45 | ..... |
| 22 | 1.40 | ..... | 1.40 | 1.05 | 1.50 | 1.55 | .90 | 1.15 | .85 | 1.50 | 1.50 | ..... |
| 23 | 1.35 | ..... | 1.30 | 1.00 | 1.50 | 1.70 | .90 | 1.10 | .85 | 1.50 | 1.40 | ..... |
| 24 | (b) | ..... | 1.25 | ..... | 2.00 | 2.00 | 1.10 | 1.05 | .85 | 1.50 | 1.45 | ..... |
| 25 | ..... | ..... | 1.30 | 1.20 | 1.70 | 1.45 | 1.10 | 1.05 | 1.00 | 1.35 | 1.45 | ..... |
| 26 | ..... | ..... | 1.20 | 1.20 | 1.60 | 1.45 | 1.00 | 1.05 | 1.00 | 1.40 | 1.45 | ..... |
| 27 | ..... | (b) | 1.25 | 1.30 | 1.80 | 1.40 | .80 | 1.05 | 1.00 | 1.35 | 1.45 | ..... |
| 28 | ..... | 1.40 | 1.35 | 1.20 | 1.60 | 1.40 | .80 | 1.05 | ..... | 1.50 | ..... | ..... |
| 29 | ..... | 1.40 | 1.30 | 1.20 | 1.50 | 1.30 | .80 | 1.05 | 1.30 | 1.50 | ..... | ..... |
| 30 | ..... | ..... | 1.25 | 1.40 | 1.50 | 1.30 | .85 | 1.05 | 1.30 | 1.55 | 1.40 | ..... |
| 31 | ..... | ..... | 1.25 | ..... | 1.45 | ..... | .85 | 1.05 | ..... | 1.50 | ..... | ..... |

[a] River partially frozen during January.
[b] No observations at gage January 24 to February 27.
[c] Ice.

*Mean daily discharge, in second-feet, of Republican River (South Fork) near Benkelman, Nebr., for 1904.* [a]

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 57 | 31 | 89 | 89 | 57 | 11 | 15 | 47 | 66 | 31 |
| 2 | 66 | 25 | 102 | 102 | 66 | 89 | 15 | 39 | 66 | 31 |
| 3 | 47 | 31 | 89 | 115 | 89 | 11 | 15 | 39 | 66 | 31 |
| 4 | 66 | 31 | 89 | 66 | 102 | 31 | 11 | 47 | 66 | ..... |
| 5 | 102 | 31 | 145 | 115 | 66 | 19 | 11 | 47 | 66 | ..... |
| 6 | 89 | 31 | 89 | 102 | 89 | 16 | 11 | 39 | 66 | ..... |
| 7 | 57 | 11 | 89 | 89 | 47 | 14 | 11 | 47 | 66 | 32 |
| 8 | 89 | 11 | 89 | 78 | 81 | 11 | 11 | 66 | 57 | ..... |
| 9 | 66 | 11 | 66 | 115 | 115 | 89 | 11 | 47 | 52 | ..... |
| 10 | 66 | 15 | 78 | 161 | 102 | 66 | 11 | 66 | 47 | ..... |
| 11 | 47 | 19 | 66 | 323 | 89 | 47 | 11 | 66 | 66 | ..... |
| 12 | 66 | 19 | 57 | 178 | 31 | 19 | 11 | 47 | 66 | ..... |
| 13 | 66 | 15 | 66 | 178 | 47 | 19 | 11 | 47 | 66 | ..... |
| 14 | 66 | 11 | 66 | 178 | 47 | 19 | 11 | 39 | 66 | ..... |
| 15 | 66 | 8 | 66 | 178 | 19 | 19 | 11 | 39 | 57 | ..... |
| 16 | 66 | 11 | 66 | 115 | 19 | 19 | 11 | 39 | 57 | ..... |
| 17 | 66 | 8 | 66 | 178 | 15 | 15 | 11 | 31 | 66 | ..... |
| 18 | 66 | 6 | 66 | 178 | 11 | 19 | 5 | 73 | 57 | ..... |
| 19 | 66 | 8 | 66 | 397 | 15 | 19 | 5 | 115 | 57 | ..... |
| 20 | 66 | 8 | 47 | 47 | 11 | 11 | 5 | 115 | 57 | ..... |
| 21 | 66 | 8 | 66 | 89 | 6 | 18 | 5 | 89 | 57 | ..... |
| 22 | 66 | 15 | 89 | 102 | 6 | 25 | 5 | 66 | 66 | ..... |
| 23 | 47 | 11 | 89 | 145 | 6 | 19 | 5 | 66 | 47 | ..... |
| 24 | 39 | 21 | 255 | 255 | 19 | 15 | 5 | 66 | 57 | ..... |
| 25 | 47 | 31 | 145 | 78 | 19 | 15 | 11 | 39 | 57 | ..... |
| 26 | 31 | 31 | 115 | 78 | 19 | 15 | 11 | 47 | 57 | ..... |
| 27 | 39 | 47 | 178 | 66 | 5 | 15 | 11 | 39 | 57 | ..... |
| 28 | 57 | 31 | 115 | 66 | 5 | 15 | 29 | 66 | 54 | ..... |
| 29 | 47 | 31 | 89 | 47 | 5 | 15 | 47 | 66 | 50 | ..... |
| 30 | 39 | 66 | 89 | 47 | 5 | 15 | 47 | 78 | 47 | ..... |
| 31 | 39 | ..... | 78 | ..... | 5 | 15 | ..... | 66 | ..... | ..... |

[a] The daily discharge was obtained indirectly according to the method outlined in the Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1899, p. 323 et seq.

† Discharge interpolated for days when the gage was not observed.

*Estimated monthly discharge of Republican River (South Fork) near Benkelman, Nebr., for 1904.*[a]

[Drainage area, 5,910 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March | 102 | 31 | 60.1 | 3,695 | 0.010 | 0.012 |
| April | 36 | 6 | 21.1 | 1,256 | .0036 | .0040 |
| May | 255 | 47 | 92.4 | 5,682 | .016 | .018 |
| June | 397 | 47 | 132 | 7,855 | .022 | .025 |
| July | 115 | 5 | 39.3 | 2,416 | .0066 | .0076 |
| August | 89 | 11 | 24.0 | 1,476 | .0041 | .0047 |
| September | 47 | 5 | 13.0 | 774 | .0022 | .0025 |
| October | 115 | 31 | 57.5 | 3,536 | .010 | .012 |
| November | 66 | 47 | 59.4 | 3,534 | .010 | .011 |
| The period | | | | 30,220 | | |

[a] Insufficient measurements were made during 1904 to make the above monthly estimate other than a rough approximation.

## REPUBLICAN RIVER NEAR BOSTWICK, NEBR.

This station was established June 6, 1904, by J. C. Stevens. It is located at the highway bridge, 1 mile southwest of Bostwick, Nebr., a station on the Burlington and Missouri River Railroad, and replaces the station formerly maintained at Superior, Nebr. A standard chain gage is fastened to the downstream hand rail in the second panel from the south end of the north span. The length of the chain from the end of the weight to the marker is 20.52 feet. The gage is read once each day by M. A. McPherson. Discharge measurements are made from the bridge to which the gage is attached. This bridge has three 150-foot spans resting on tubular concrete piers. The downstream hand rail is marked every 10 feet with Roman numerals. The initial point for soundings is the zero mark on the hand rail, which is in line with the south face of the north downstream pier. The channel is straight for about 1,000 feet above and below the station, and the current is not sluggish. The right bank is low, timbered, and subject to overflow during high water. The left bank is high, timbered, and does not overflow. The bed of the stream is composed of sand and is shifting. The depths are fairly uniform. There is but one channel, except at extreme low stages. There is some tendency to form small islands in all parts of the channel. The bench mark is the top of the cast-iron bearing shoe of the upper chord of the north span, downstream truss, at the north end of the span. The shoe rests on rollers on the top of the pier and has three openings. The east opening is the bench mark. Its elevation is 15.75 feet above the datum of the gage. Bench mark No. 2 is the northeast cardinal point of the rim or

edge of the cover plate of the pier at the south end of truss described above. Its elevation is 15.89 feet above the gage datum.

The object in moving the station from Superior to Bostwick was to obtain a greater degree of accuracy than could possibly be obtained at the former place on account of the complicated conditions existing there in the way of dam, mill race, etc.

The observations at this station during 1904 have been made under the direction of J. C. Stevens, resident hydrographer.

*Discharge measurements of Republican River near Bostwick, Nebr., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Ft. per sec.* | *Feet.* | *Second-feet.* |
| June 5 | J. C. Stevens | 407 | 510 | 1.73 | 2.10 | 884 |
| June 6 | do | 428 | 682 | 1.89 | 2.64 | 1,289 |
| June 29 | do | 437 | 993 | 2.39 | 3.50 | 2,379 |
| July 8 | R. D. Hubbard | 430 | 761 | 2.36 | 3.05 | 1,799 |
| August 16 | do | | 257 | 1.55 | 1.50 | 397 |
| December 8 | J. A. Green | | | | 1.70 | 520 |

*Mean daily gage height, in feet, of Republican River near Bostwick, Nebr., for 1904.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|
| 1 | | 2.90 | 1.45 | 1.40 | 1.40 | 1.60 | 1.70 |
| 2 | | 2.70 | 1.40 | 1.25 | 1.35 | 1.70 | (a) |
| 3 | | 2.65 | 1.40 | 1.20 | 1.30 | 1.75 | |
| 4 | | 3.70 | 1.45 | 1.30 | 1.35 | 1.70 | |
| 5 | | 6.10 | 1.50 | 1.40 | 1.40 | 1.70 | |
| 6 | 2.40 | 6.25 | 1.75 | 1.25 | 1.35 | 1.70 | |
| 7 | 2.20 | 3.70 | 1.70 | 1.30 | 1.35 | 1.65 | |
| 8 | 1.50 | 3.05 | 2.30 | 1.25 | 1.30 | 1.65 | |
| 9 | 2.10 | 3.07 | 2.20 | 1.15 | 1.35 | 1.70 | |
| 10 | 2.15 | 3.90 | 1.90 | 1.25 | 1.30 | 1.65 | |
| 11 | 2.00 | 3.40 | 1.70 | 1.25 | 1.35 | 1.65 | |
| 12 | 2.00 | 3.10 | 1.60 | 1.20 | 1.40 | 1.65 | |
| 13 | 1.95 | 3.25 | 1.60 | 1.20 | 1.35 | 1.65 | |
| 14 | 1.90 | 3.10 | 1.55 | 1.10 | 1.45 | 1.70 | |
| 15 | 3.10 | 2.75 | 1.50 | 1.05 | 1.40 | 1.65 | |
| 16 | 2.95 | 2.55 | 1.45 | 1.00 | 1.50 | 1.70 | |
| 17 | 2.40 | 2.30 | 1.45 | 1.00 | 1.45 | 1.70 | |
| 18 | 2.45 | 2.15 | 1.60 | .95 | 1.40 | 1.70 | |
| 19 | 2.75 | 2.05 | b 1.50 | .90 | 1.45 | 1.65 | |
| 20 | 2.45 | 2.00 | 2.30 | 1.00 | 2.00 | 1.70 | |
| 21 | 2.75 | 2.00 | 1.85 | .95 | 2.40 | 1.70 | |
| 22 | 2.50 | 1.95 | 1.70 | 1.00 | 2.30 | 1.70 | |
| 23 | 2.55 | 1.90 | 1.45 | 1.00 | 2.30 | 1.65 | |
| 24 | 3.68 | 1.85 | 1.45 | .95 | 2.25 | 1.70 | |
| 25 | 4.10 | 1.80 | 1.40 | 1.00 | 2.15 | 1.70 | |
| 26 | 4.90 | 1.75 | 1.35 | .95 | 2.10 | 1.70 | |
| 27 | 4.80 | 1.70 | 1.40 | 1.00 | 2.05 | 1.70 | |
| 28 | 3.85 | 1.65 | 1.35 | 1.15 | 1.95 | 1.70 | |
| 29 | 3.50 | 1.50 | 1.25 | 1.20 | 1.80 | 1.70 | |
| 30 | 3.10 | 1.50 | 1.40 | 1.30 | 1.70 | 1.70 | |
| 31 | | 1.45 | 1.50 | | 1.65 | | |

a River frozen over. b Gage height estimated. No gage reading taken, owing to sand at the gage.

*Rating table for Republican River near Bostwick Nebr., from June 6 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 60 | 2.30 | 1,020 | 3.70 | 2,670 | 5.10 | 5,010 |
| 1.00 | 110 | 2.40 | 1,115 | 3.80 | 2,815 | 5.20 | 5,210 |
| 1.10 | 160 | 2.50 | 1,210 | 3.90 | 2,965 | 5.30 | 5,410 |
| 1.20 | 215 | 2.60 | 1,310 | 4.00 | 3,115 | 5.40 | 5,610 |
| 1.30 | 275 | 2.70 | 1,415 | 4.10 | 3,265 | 5.50 | 5,820 |
| 1.40 | 335 | 2.80 | 1,525 | 4.20 | 3,420 | 5.60 | 6,030 |
| 1.50 | 400 | 2.90 | 1,635 | 4.30 | 3,580 | 5.70 | 6,240 |
| 1.60 | 465 | 3.00 | 1,750 | 4.40 | 3,750 | 5.80 | 6,460 |
| 1.70 | 535 | 3.10 | 1,870 | 4.50 | 3,920 | 5.90 | 6,680 |
| 1.80 | 605 | 3.20 | 1,995 | 4.60 | 4,090 | 6.00 | 6,900 |
| 1.90 | 680 | 3.30 | 2,120 | 4.70 | 4,270 | 6.10 | 7,130 |
| 2.00 | 760 | 3.40 | 2,250 | 4.80 | 4,450 | 6.20 | 7,360 |
| 2.10 | 845 | 3.50 | 2,385 | 4.90 | 4,630 | 6.30 | 7,600 |
| 2.20 | 930 | 3.60 | 2,525 | 5.00 | 4,820 | | |

The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1904. It is well defined between gage heights 1.5 feet and 3.5 feet. The table has been extended beyond these limits.

*Estimated monthly discharge of Republican River near Bostwick, Nebr., for 1904.*

[Drainage area, 23,270 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| June 6–30 | 4,630 | 400 | 1,666 | 82,610 | 0.072 | 0.067 |
| July | 7,480 | 367 | 1,658 | 101,900 | .071 | .082 |
| August | 1,020 | 245 | 472 | 29,020 | .020 | .023 |
| September | 335 | 60 | 181 | 10,770 | .0078 | .0087 |
| October | 1,115 | 275 | 514 | 31,600 | .022 | .025 |
| November | 570 | 465 | 523 | 31,120 | .022 | .025 |
| The period | | | | 287,000 | | |

## REPUBLICAN RIVER AT JUNCTION, KANS.

The gaging station at this point, established by Arthur P. Davis, April 26, 1895, is located at the wagon bridge at the north end of Washington street, just above the mouth of the river. The gage consists of two oak timbers bolted to a post and to a cottonwood tree. The observer is J. H. Rathert. The channel is straight for 300 feet above and below the station, broken by three piers. The right bank is high, but the left is low and may overflow at high water. The bed of the stream is sandy and liable to change. The flow is moderately rapid.

On October 23, 1900, a bench mark was established at an elevation of 12.35 feet above the zero of the old gage. It is a spike driven in the west side of a cottonwood tree 18 inches in diameter and 10 feet west of the bridge. The spike is about 2 feet above the ground. The second bench mark, established March 15, 1904, is the top of a stone at base of abutment south of No. 3. The elevation is 14.28 feet above the zero of the gage. The high water of 1904 made a second channel north of the bridge. The county put in a pile bridge 220 feet long across this, and November 4, 1904, the channel was 158 feet wide and carried about three-fourths of the water in the river.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Republican River at Junction, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 15 | W. G. Russell | 163 | 339 | 2.56 | 4.10 | 868 |
| April 26 | do | | 2,044 | 5.74 | 8.80 | 11,730 |
| June 5 | M. C. Hinderlider | 295 | 1,655 | 5.37 | 8.35 | 8,887 |
| July 8 | W. G. Russell | 476 | 3,085 | 4.76 | 10.40 | 14,700 |
| July 9 | do | 458 | 2,855 | 4.59 | 9.95 | 13,100 |
| July 21 | Russell and Murphy | 245 | 594 | 3.56 | 4.50 | 2,113 |
| November 4 | do | 192 | 433 | 1.90 | 3.40 | 824 |

*Mean daily gage height, in feet, of Republican River at Junction, Kans., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.97 | 4.40 | 4.30 | 3.85 | 4.35 | 7.60 | 6.55 | 3.60 | 3.20 | 3.00 | 3.50 | 3.30 |
| 2 | 4.20 | 4.40 | 4.30 | 3.90 | 4.15 | 5.80 | 6.05 | 3.75 | 3.20 | 3.00 | 3.50 | 3.30 |
| 3 | 4.20 | 4.40 | 5.05 | 4.05 | 3.95 | 6.10 | 5.70 | 3.70 | 3.18 | 3.00 | 3.50 | 3.30 |
| 4 | 4.20 | 4.40 | 5.10 | 4.00 | 3.85 | 7.70 | 6.85 | 3.85 | 3.08 | 3.00 | 3.45 | 3.30 |
| 5 | 4.20 | 4.40 | 4.72 | 3.90 | 3.72 | 8.58 | 6.85 | 3.85 | 3.30 | 3.00 | 3.40 | 3.30 |
| 6 | 4.20 | 4.40 | 4.60 | 3.90 | 3.95 | 6.28 | 10.65 | 3.65 | 3.12 | 3.00 | 3.40 | 3.30 |
| 7 | 4.25 | 4.40 | 4.48 | 3.80 | 3.90 | 5.70 | 9.90 | 3.58 | 3.02 | 3.00 | 3.40 | 3.20 |
| 8 | 4.35 | 4.40 | 4.40 | 3.80 | 5.70 | 5.30 | 10.45 | 3.45 | 3.00 | 3.00 | 3.40 | 3.20 |
| 9 | 4.35 | 4.40 | 4.32 | 3.80 | 6.78 | 5.20 | 9.52 | 3.50 | 3.02 | 3.00 | 3.40 | 3.20 |
| 10 | 4.40 | 4.40 | 4.30 | 3.80 | 6.50 | 6.95 | 7.55 | 3.40 | 3.00 | 2.90 | 3.40 | 3.20 |
| 11 | 4.35 | 4.40 | 4.30 | 3.80 | 5.70 | 7.25 | 6.40 | 3.45 | 3.10 | 2.90 | 3.40 | 3.20 |
| 12 | 4.35 | 4.35 | 4.30 | 3.80 | 5.05 | 7.30 | 6.40 | 4.05 | 3.00 | 2.90 | 3.40 | 3.20 |
| 13 | 4.75 | 4.30 | 4.22 | 3.80 | 4.78 | 5.35 | 6.70 | 3.92 | 3.08 | 3.00 | 3.40 | 3.12 |
| 14 | 5.02 | 4.35 | 4.28 | 3.80 | 4.65 | 4.75 | 5.55 | 3.70 | 3.00 | 3.00 | 3.30 | 3.10 |
| 15 | 4.75 | 4.40 | 4.20 | 3.80 | 4.55 | 6.50 | 5.35 | 3.50 | 3.00 | 3.00 | 3.30 | 3.10 |
| 16 | 4.45 | 4.40 | 4.25 | 3.80 | 4.60 | 10.55 | 5.30 | 3.50 | 3.15 | 3.00 | 3.35 | 3.10 |
| 17 | 4.25 | 4.48 | 4.00 | 3.80 | 4.30 | 8.65 | 4.90 | 3.50 | 3.05 | 3.00 | 3.37 | 3.10 |
| 18 | 4.20 | 4.50 | 3.90 | 3.80 | 4.10 | 7.05 | 4.70 | 3.50 | 3.02 | 3.00 | 3.30 | 3.10 |
| 19 | 4.20 | 4.65 | 4.00 | 3.80 | 4.02 | 6.10 | 4.40 | 3.65 | 2.95 | 4.00 | 3.30 | 3.12 |
| 20 | 4.28 | 4.72 | 4.00 | 4.30 | 3.88 | 5.45 | 4.52 | 3.50 | 3.00 | 4.00 | 3.30 | 3.25 |
| 21 | 4.20 | 4.80 | 4.00 | 4.40 | 3.78 | 5.65 | 4.50 | 3.48 | 3.00 | 3.15 | 3.30 | 3.45 |
| 22 | 3.70 | 4.68 | 3.90 | 4.10 | 3.70 | 6.05 | 4.70 | 3.55 | 2.70 | 3.10 | 3.30 | 3.32 |
| 23 | 3.50 | 4.40 | 3.90 | 4.97 | 3.70 | 5.90 | 4.15 | 3.35 | 2.60 | 3.10 | 3.30 | 3.52 |
| 24 | 3.40 | 4.32 | 3.90 | 4.80 | 3.70 | 5.55 | 3.90 | 4.30 | 2.65 | 3.15 | 3.30 | 3.40 |
| 25 | 3.40 | 4.30 | 4.00 | 7.50 | 3.70 | 12.05 | 3.90 | 3.95 | 2.70 | 3.65 | 3.30 | 3.40 |
| 26 | 3.40 | 4.30 | 4.40 | 9.10 | 3.60 | 12.85 | 3.80 | 3.70 | 2.45 | 3.75 | 3.30 | 3.40 |
| 27 | 3.40 | 4.30 | 4.10 | 7.55 | 3.60 | 10.95 | 3.78 | 3.45 | 2.65 | 3.40 | 3.30 | 3.40 |
| 28 | 3.40 | 4.30 | 3.90 | 6.60 | 4.10 | 9.00 | 3.70 | 3.40 | 2.60 | 3.30 | 3.30 | 3.40 |
| 29 | 3.40 | 4.30 | 3.90 | 5.50 | 8.60 | 7.75 | 3.65 | 3.35 | 2.85 | 3.30 | 3.30 | 3.55 |
| 30 | 3.90 | ..... | 3.98 | 4.58 | 5.70 | 7.40 | 3.65 | 3.22 | 3.00 | 3.50 | 3.30 | 3.65 |
| 31 | 4.40 | ..... | 3.90 | ..... | 5.35 | ..... | 3.65 | 3.20 | ..... | 3.50 | ..... | 3.80 |

River frozen January 3–8; January 24 to February 11; February 21–22.

*Rating table for Republican River at Junction, Kans., from January 1 to May 28, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.40 | 400 | 4.60 | 1,480 | 5.80 | 3,200 | 7.00 | 6,000 |
| 3.50 | 455 | 4.70 | 1,600 | 5.90 | 3,400 | 7.20 | 6,600 |
| 3.60 | 510 | 4.80 | 1,720 | 6.00 | 3,600 | 7.40 | 7,200 |
| 3.70 | 570 | 4.90 | 1,840 | 6.10 | 3,800 | 7.60 | 7,800 |
| 3.80 | 630 | 5.00 | 1,960 | 6.20 | 4,000 | 7.80 | 8,400 |
| 3.90 | 735 | 5.10 | 2,085 | 6.30 | 4,200 | 8.00 | 9,000 |
| 4.00 | 840 | 5.20 | 2,210 | 6.40 | 4,400 | 8.20 | 9,600 |
| 4.10 | 945 | 5.30 | 2,365 | 6.50 | 4,650 | 8.40 | 10,200 |
| 4.20 | 1,050 | 5.40 | 2,520 | 6.60 | 4,900 | 8.60 | 10,900 |
| 4.30 | 1,155 | 5.50 | 2,680 | 6.70 | 5,150 | 8.80 | 11,400 |
| 4.40 | 1,260 | 5.60 | 2,840 | 6.80 | 5,400 | 9.00 | 12,000 |
| 4.50 | 1,370 | 5.70 | 3,020 | 6.90 | 5,700 | | |

The above table is applicable only for open-channel conditions. It is based upon discharge measurements of 1902 and 1903 and one in 1904. It is fairly well defined between 3.6 feet and 9 feet.

*Rating table for Republican River at Junction, Kans., from May 29 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.40 | 220 | 3.90 | 1,295 | 5.30 | 3,010 | 7.40 | 6,650 |
| 2.50 | 260 | 4.00 | 1,400 | 5.40 | 3,150 | 7.60 | 7,080 |
| 2.60 | 305 | 4.10 | 1,510 | 5.50 | 3,295 | 7.80 | 7,530 |
| 2.70 | 355 | 4.20 | 1,620 | 5.60 | 3,440 | 8.00 | 8,000 |
| 2.80 | 410 | 4.30 | 1,735 | 5.70 | 3,590 | 8.20 | 8,480 |
| 2.90 | 470 | 4.40 | 1,850 | 5.80 | 3,745 | 8.40 | 8,980 |
| 3.00 | 530 | 4.50 | 1,970 | 5.90 | 3,900 | 8.60 | 9,490 |
| 3.10 | 595 | 4.60 | 2,090 | 6.00 | 4,060 | 8.80 | 10,010 |
| 3.20 | 665 | 4.70 | 2,215 | 6.20 | 4,390 | 9.00 | 10,550 |
| 3.30 | 740 | 4.80 | 2,340 | 6.40 | 4,730 | 9.50 | 11,950 |
| 3.40 | 820 | 4.90 | 2,470 | 6.60 | 5,085 | 10.00 | 13,450 |
| 3.50 | 905 | 5.00 | 2,600 | 6.80 | 5,450 | 10.50 | 15,030 |
| 3.60 | 995 | 5.10 | 2,735 | 7.00 | 5,830 | 11.00 | 16,700 |
| 3.70 | 1,090 | 5.20 | 2,870 | 7.20 | 6,230 | 12.00 | 20,200 |
| 3.80 | 1,190 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1904. It is fairly well defined between gage heights 3.4 feet and 10.5 feet. The table has been extended beyond these limits. Owing to the shifting character of the bed, the insufficiency of measurements may lead to some error in the application of this table.

*Estimated monthly discharge of Republican River at Junction, Kans., for 1904.*

[Drainage area, 25,840 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January [a] | 1,985 | 400 | 990 | 60,870 | 0.038 | 0.044 |
| February [a] | 1,720 | 1,155 | 1,288 | 74,090 | .050 | .054 |
| March | 2,085 | 735 | 1,081 | 66,470 | .042 | .048 |
| April | 12,300 | 630 | 1,877 | 111,700 | .073 | .081 |
| May | 9,490 | 510 | 1,764 | 108,500 | .068 | .078 |
| June | 23,300 | 2,278 | 7,083 | 421,500 | .274 | .306 |
| July | 15,520 | 1,042 | 4,321 | 265,700 | .167 | .192 |
| August | 1,735 | 665 | 1,007 | 61,920 | .039 | .045 |
| September | 740 | 240 | 510 | 30,350 | .020 | .022 |
| October | 1,400 | 470 | 674 | 41,440 | .026 | .030 |
| November | 905 | 740 | 788 | 46,890 | .030 | .033 |
| December | 1,190 | 595 | 747 | 45,930 | .029 | .033 |
| The year | 23,300 | 240 | 1,844 | 1,335,000 | .071 | .966 |

[a] River frozen part of January and February. Estimates given above are for open channel, and are probably slightly in error.

## SMOKY HILL RIVER AT ELLSWORTH, KANS.

This station, established April 16, 1895, by A. P. Davis, is located at the highway bridge on Douglass avenue, Ellsworth, Kans. The gage is in two sections. The first section is an inclined ash timber, graduated to read direct in feet and tenths from zero to 4 feet, securely fastened to the iron pier of the bridge and to posts driven into the bed of the river. The second section is a 2 by 6 inch timber 17 feet long spiked to the same pier. It is graduated to feet and tenths from 3.7 feet to 21 feet. The gage is read once each day by Thomas Coyne. Discharge measurements are made from the downstream side of the three-span steel bridge, 293 feet long between abutments. The spans are supported at interior points by four iron posts under each corner. The initial point for soundings is at the north end on the downstream side of the bridge. The channel is straight above and below the station during high water; at other times it is slightly curved. The current is moderate at low, and swift at high stages. Both banks are low, wooded, and subject to overflow. The bed of the stream is composed of sand, free from vegetation and shifting. Bench mark No. 1 is a nail driven into the base of a box-elder tree near the southeast corner of the bridge, 90 feet from the gage. Its elevation is 13.07

feet above the zero of the gage. Bench mark No. 2 is the top of a nail driven into a root on the north side of an elm tree 2 feet in diameter about 45 feet west of bench mark No. 1. Its elevation is 11.34 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Smoky Hill River at Ellsworth, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 11 | W. G. Russell | 60 | 38 | 1.47 | 1.20 | 56 |
| September 30 | do | 64 | 56 | 1.46 | 1.45 | 82 |

*Mean daily gage height, in feet, of Smoky Hill River at Ellsworth, Kans., for 1904.*

| Day. | Jan.[a] | Feb.[a] | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.15 | 1.1 | 0.9 | 1.05 | 1.15 | 1.3 | 5.5 | 1.9 | 1.45 | 3.0 | 1.2 | 0.95 |
| 2 | ..... | 1.2 | .85 | 1.0 | 1.1 | 1.25 | 7.6 | 1.8 | 1.4 | 2.0 | 1.15 | 1.0 |
| 3 | ..... | 1.2 | .85 | 1.0 | 1.1 | [b]4.8 | 4.3 | 1.7 | 1.4 | 1.6 | 1.15 | 1.0 |
| 4 | ..... | 1.2 | .85 | 1.0 | 1.3 | 2.4 | 3.6 | 2.0 | 1.4 | 1.55 | 1.15 | 1.0 |
| 5 | ..... | 1.1 | .85 | 1.0 | 1.4 | 2.1 | 2.7 | 2.0 | 1.35 | 1.5 | 1.15 | 1.0 |
| 6 | ..... | 1.05 | .85 | 1.05 | 1.8 | 1.9 | [c]10.4 | 1.9 | 1.35 | 1.4 | 1.15 | 1.0 |
| 7 | ..... | 1.0 | .85 | 1.05 | 1.9 | 1.8 | 6.6 | 2.1 | 1.35 | 1.45 | 1.15 | 1.05 |
| 8 | ..... | 1.0 | .85 | 1.05 | 4.6 | 1.65 | 4.4 | 1.7 | 1.3 | 1.35 | 1.1 | 1.05 |
| 9 | 1.2 | 1.0 | .85 | 1.0 | 3.3 | 1.5 | 4.8 | 1.6 | 1.3 | 1.3 | 1.1 | 1.05 |
| 10 | 1.0 | [a]1.0 | 1.2 | 1.0 | 2.7 | 1.9 | 4.0 | 1.6 | 1.25 | 1.25 | 1.1 | 1.15 |
| 11 | 1.0 | [a]1.0 | 1.2 | 1.0 | 2.4 | 1.5 | 3.4 | 1.55 | 1.25 | 1.25 | 1.1 | 1.1 |
| 12 | 1.2 | 1.0 | 1.25 | 1.0 | 2.2 | 1.5 | 3.1 | 1.5 | 1.2 | 1.2 | 1.05 | 1.1 |
| 13 | 1.2 | 1.0 | 1.25 | 1.0 | 2.0 | 1.4 | 2.9 | 1.5 | 1.2 | 1.15 | 1.05 | 1.1 |
| 14 | 1.15 | 1.2 | 1.25 | 1.0 | 2.0 | 1.4 | 1.7 | 1.4 | 1.2 | 1.1 | 1.1 | 1.05 |
| 15 | 1.1 | 1.2 | 1.2 | 1.0 | 1.9 | 1.5 | 1.5 | 1.4 | 1.1 | 1.1 | 1.1 | 1.05 |
| 16 | 1.1 | 1.2 | 1.2 | 1.0 | 1.8 | 1.5 | 1.35 | 1.4 | 1.1 | 1.1 | 1.1 | 1.05 |
| 17 | 1.1 | 1.2 | 1.2 | 1.0 | 1.7 | 1.5 | 1.2 | 1.4 | 1.0 | 1.1 | 1.05 | 1.0 |
| 18 | 1.1 | 1.2 | 1.15 | 1.0 | 1.6 | 1.6 | 1.1 | 1.5 | 1.0 | 1.05 | 1.05 | 1.0 |
| 19 | 1.1 | 1.2 | 1.15 | 1.0 | 1.5 | 1.7 | 1.7 | 2.5 | 1.0 | 1.05 | 1.0 | 1.0 |
| 20 | 1.1 | 1.2 | 1.15 | 1.05 | 1.5 | 1.7 | 2.3 | 2.2 | 1.0 | 1.05 | 1.0 | 1.05 |
| 21 | 1.1 | 1.2 | 1.15 | 1.05 | 1.45 | 1.6 | 2.9 | 2.0 | 1.05 | 1.0 | 1.0 | 1.05 |
| 22 | 1.1 | 1.2 | 1.1 | 1.05 | 1.4 | 1.5 | 2.8 | 2.2 | 1.1 | 1.0 | 1.0 | 1.1 |
| 23 | 1.1 | 1.0 | 1.1 | 1.7 | 1.4 | 1.4 | 3.0 | 2.45 | 1.05 | 1.0 | 1.0 | 1.05 |
| 24 | 1.1 | .9 | 1.5 | 1.4 | 1.4 | 1.4 | 2.5 | 2.15 | 1.0 | 1.0 | 1.0 | 1.0 |
| 25 | 1.1 | .9 | 1.2 | 1.25 | 1.35 | 3.3 | 2.1 | 1.9 | 1.0 | 1.3 | 1.0 | 1.0 |
| 26 | 1.1 | .9 | 1.15 | 1.25 | 1.6 | 2.15 | 1.9 | 1.8 | 1.0 | 1.25 | 1.0 | 1.0 |
| 27 | 1.1 | .9 | 1.1 | 1.25 | 1.35 | 1.9 | 1.9 | 1.75 | 2.0 | 1.2 | .95 | ([a]) |
| 28 | 1.1 | .9 | 1.05 | 1.2 | 1.35 | 1.7 | 1.85 | 1.7 | 1.5 | 1.2 | .95 | |
| 29 | 1.1 | .9 | 1.05 | 1.2 | 1.9 | 2.3 | 1.8 | 1.6 | 1.9 | 1.2 | .95 | |
| 30 | 1.1 | ..... | 1.0 | 1.2 | 1.4 | 2.2 | 1.7 | 1.55 | 1.6 | 1.2 | .95 | |
| 31 | 1.1 | ..... | 1.0 | ..... | 1.35 | ..... | 2.0 | 1.5 | ..... | 1.2 | ..... | |

[a] River frozen January 1 to February 22; also December 27–31.
[b] At 6 a. m. gage read 7.0. At 2 p. m. gage read 4.8.
[c] At 9 a. m. gage read 11.0. At 2 p. m. gage read 9.8.

*Rating table for Smoky Hill River at Ellsworth, Kans., from January 1, 1903, to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 5 | 2.10 | 209 | 3.70 | 946 | 6.40 | 2,910 |
| .60 | 9 | 2.20 | 239 | 3.80 | 1,010 | 6.60 | 3,075 |
| .70 | 13 | 2.30 | 271 | 3.90 | 1,075 | 6.80 | 3,241 |
| .80 | 17 | 2.40 | 305 | 4.00 | 1,141 | 7.00 | 3,410 |
| .90 | 21 | 2.50 | 342 | 4.20 | 1,275 | 7.20 | 3,580 |
| 1.00 | 26 | 2.60 | 381 | 4.40 | 1,410 | 7.40 | 3,750 |
| 1.10 | 32 | 2.70 | 422 | 4.60 | 1,549 | 7.60 | 3,920 |
| 1.20 | 40 | 2.80 | 465 | 4.80 | 1,690 | 7.80 | 4,090 |
| 1.30 | 50 | 2.90 | 510 | 5.00 | 1,834 | 8.00 | 4,260 |
| 1.40 | 62 | 3.00 | 557 | 5.20 | 1,980 | 8.50 | 4,685 |
| 1.50 | 76 | 3.10 | 606 | 5.40 | 2,129 | 9.00 | 5,110 |
| 1.60 | 92 | 3.20 | 657 | 5.60 | 2,280 | 9.50 | 5,535 |
| 1.70 | 110 | 3.30 | 710 | 5.80 | 2,434 | 10.00 | 5,960 |
| 1.80 | 131 | 3.40 | 765 | 6.00 | 2,590 | 10.50 | 6,385 |
| 1.90 | 155 | 3.50 | 823 | 6.20 | 2,748 | 11.00 | 6,810 |
| 2.00 | 181 | 3.60 | 883 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 12 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1 foot and 6 feet. The table has been extended beyond these limits. Above gage height 7 feet the rating curve is a tangent, the difference being 85 per tenth.

*Estimated monthly discharge of Smoky Hill River at Ellsworth, Kans., for 1904.*

[Drainage area, 7,980 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January [a] | ..... | ..... | ..... | ..... | ..... | ..... |
| February 23–29 | 26 | 21 | 21.7 | 300 | 0.0027 | 0.0007 |
| March | 76 | 19 | 32.6 | 2,004 | .0041 | .0047 |
| April | 110 | 26 | 34.0 | 2,023 | .0043 | .0048 |
| May | 1,549 | 32 | 178 | 10,940 | .022 | .025 |
| June | 1,690 | 45 | 191 | 11,360 | .024 | .027 |
| July | 6,300 | 32 | 901 | 55,400 | .113 | .130 |
| August | 342 | 62 | 138 | 8,485 | .017 | .020 |
| September | 181 | 26 | 52.4 | 3,118 | .0066 | .0074 |
| October | 557 | 26 | 64.7 | 3,978 | .0081 | .0093 |
| November | 40 | 23 | 29.9 | 1,779 | .0037 | .0041 |
| December 1–26 | 36 | 23 | 28.2 | 1,454 | .0035 | .0034 |
| The period | ..... | ..... | ..... | 100,800 | ..... | ..... |

[a] River frozen January 1 to February 22 and December 27 to 31.

## SMOKY HILL RIVER NEAR SOLOMON, KANS.

This station was established April 11, 1904, by M. C. Hinderlider, for the purpose of making flood water observations. It is located at the highway bridge three-fourths mile south of Solomon, Kans. A plain vertical gage, graduated to feet and tenths from 15 to 31 feet, is painted in black on the north face of the upstream tubular pier on the left bank. During 1904 the gage was read once daily, or oftener during sudden and dangerous changes in the stages of the river, by George Lamb. Discharge measurements are made from the lower side of the three-span iron-pier bridge at which the gage is located. The initial point for soundings is the inside face of the left abutment. The channel is straight for about 500 feet above and below the station, and the current is sluggish. Both banks are high, wooded, and liable to overflow. The bed of the stream is composed of silt and sand and is probably shifting. At low stages all the water passes beneath the center span of the bridge. At extremely high stages the left and right banks are overflowed for long distances out from the river. Bench mark No. 1 is a cross cut into the topstone of the wing wall of the left abutment on the upstream side. Its elevation is 32.429 feet above gage datum.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurement of Smoky Hill River near Solomon, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 5 | M. C. Hinderlider | 2,175 | 2,841 | 3.29 | 18.85 | 9,354 |

*Mean daily gage height, in feet, of Smoky Hill River near Solomon, Kans., for 1904.*

| Day. | Apr. | May. | June. | July. | Day. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 17 | | | | |
| 2 | | | | | 18 | | | | |
| 3 | | | | | 19 | | | | |
| 4 | | | 16.45 | | 20 | | | | |
| 5 | | | 19.35 | 16.90 | 21 | | | | |
| 6 | | | 21.55 | 22.85 | 22 | | | | |
| 7 | | | 22.65 | 25.90 | 23 | | | | |
| 8 | | | 22.60 | 27.25 | 24 | | | | |
| 9 | | | | 27.80 | 25 | | | | |
| 10 | | | | 27.90 | 26 | | | 20.55 | |
| 11 | | | | 27.90 | 27 | 15.40 | | 23.45 | |
| 12 | | | | 27.70 | 28 | | | 22.55 | |
| 13 | | | | 26.90 | 29 | | 15.30 | 20.00 | |
| 14 | | | | 25.00 | 30 | | | 15.35 | |
| 15 | | | | 21.80 | 31 | | | | |
| 16 | | | | | | | | | |

## BEAVER RIVER (LADDER CREEK) NEAR SCOTT CITY, KANS.

This station was established as a gaging station May 18, 1904, by W. G. Russell. It is located about 18 miles north of Scott City, Kans., about 250 yards southwest of H. H. Hatheway's residence. A plain staff gage, graduated to feet and tenths, is spiked in a vertical position to a willow tree on the left bank. It is read daily by James H. Drain. Discharge measurements are made at low water by wading; at high water the flow must be computed from the cross section and the slope, both of which were taken at the time the gage was established. The initial point for soundings is at the right bank. The channel at low water is very crooked, but after the water covers the bottom the channel is straight for about 100 feet above and below the station. There is a heavy growth of willows and other small brush along the channel. The right bank is high, wooded, and does not overflow. The left bank is low, wooded, and subject to overflow. The bed of the stream is composed of mud, covered with vegetation, and is permanent. There is but one channel at all stages. The undergrowth and drift will prevent very accurate measurements of this stream. The bench mark is the top of a nail near the surface of the ground driven into the root of a willow tree about 8 inches in

diameter, located on the right bank of the creek about 20 feet northeast of the gage. Its elevation is 3.04 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurement of Beaver River (Ladder Creek) near Scott City, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 18 | W. G. Russell | 10 | 2.9 | 1.79 | 1.00 | 5.2 |

*Mean daily gage height, in feet, of Beaver River (Ladder Creek) near Scott City, Kans., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 1.3 | 1.2 | 0.9 | 1.0 | 2.0 | 1.4 | 1.7 |
| 2 | ..... | 1.3 | 1.0 | 1.0 | 1.0 | 1.8 | 1.4 | 1.7 |
| 3 | ..... | 2.0 | 1.3 | 1.0 | 1.0 | 1.8 | 1.5 | 1.7 |
| 4 | ..... | 2.8 | 2.2 | .9 | 1.0 | 1.8 | 1.5 | 1.7 |
| 5 | ..... | 1.8 | 2.1 | .9 | 1.0 | 1.8 | 1.5 | 1.7 |
| 6 | ..... | 1.6 | 3.4 | .9 | 1.0 | 1.4 | 1.5 | 1.7 |
| 7 | ..... | 1.8 | 3.3 | 1.0 | 1.0 | 1.4 | 1.5 | 1.7 |
| 8 | ..... | 1.3 | 2.1 | 1.0 | 1.0 | 1.4 | 1.5 | 1.7 |
| 9 | ..... | 1.3 | 1.4 | 1.0 | 1.0 | 1.4 | 1.6 | 1.7 |
| 10 | ..... | 1.8 | 1.4 | 1.0 | 1.0 | 1.4 | 1.6 | 1.7 |
| 11 | ..... | 1.6 | 1.4 | 1.0 | 1.0 | 1.5 | 1.6 | 1.7 |
| 12 | ..... | 1.6 | 1.4 | 1.0 | 1.0 | 1.5 | 1.6 | 1.8 |
| 13 | ..... | 1.4 | 1.3 | 1.0 | 1.0 | 1.5 | 1.5 | 1.8 |
| 14 | ..... | 1.2 | 1.3 | 1.0 | 1.2 | 1.5 | 1.5 | 1.8 |
| 15 | ..... | 1.0 | 1.3 | 2.0 | 1.2 | 1.5 | 1.5 | 1.8 |
| 16 | ..... | 1.1 | 1.2 | 2.0 | 1.4 | 1.4 | 1.6 | 1.8 |
| 17 | ..... | 1.0 | 1.3 | 2.0 | 1.6 | 1.4 | 1.6 | 1.8 |
| 18 | 1.0 | 1.0 | 1.3 | 1.6 | 1.4 | 1.4 | 1.6 | 1.8 |
| 19 | 1.0 | 2.0 | 1.3 | 1.6 | 1.2 | 1.5 | 1.6 | 1.8 |
| 20 | 1.0 | 1.8 | 1.3 | 1.6 | 1.2 | 1.5 | 1.6 | 1.8 |
| 21 | 1.0 | 1.7 | 1.3 | 1.0 | 1.2 | 1.6 | 1.6 | 1.8 |
| 22 | 1.3 | 1.6 | 1.3 | 1.0 | 1.2 | 1.6 | 1.6 | 1.8 |
| 23 | 1.2 | 1.5 | 1.4 | 1.0 | 1.2 | 1.5 | 1.6 | 1.8 |
| 24 | 1.2 | 1.5 | 1.4 | 1.0 | 1.2 | 1.5 | 1.6 | 1.8 |
| 25 | 1.2 | 1.4 | 1.4 | 1.0 | 1.6 | 1.5 | 1.6 | 1.6 |
| 26 | 1.0 | 2.3 | 1.2 | 1.0 | 1.6 | 1.4 | 1.6 | 1.6 |
| 27 | 1.0 | 2.1 | 1.0 | 1.0 | 1.8 | 1.4 | 1.6 | 1.6 |
| 28 | 2.2 | 1.5 | 1.0 | 1.0 | 1.8 | 1.3 | 1.6 | 1.6 |
| 29 | 2.3 | 1.4 | 1.0 | 1.05 | 1.8 | 1.2 | 1.6 | 1.6 |
| 30 | 2.0 | 1.3 | 1.0 | 1.05 | 2.0 | 1.6 | 1.7 | 1.6 |
| 31 | 1.6 | ..... | 1.0 | 1.1 | ..... | 1.6 | ..... | 1.6 |

## BLUE RIVER NEAR MANHATTAN, KANS.

The gaging station, established April 12, 1895, by A. P. Davis, is at the county bridge 4 miles north of Manhattan. The low-water gage is a chain gage on the hand railing of the bridge on the east side and south end of the bridge. It reads from zero to 14 feet from a scale spiked to the hand railing. The second section is an oak rod bolted to the north face of the south pier, and reads from 11.3 to 17 feet. The third section is a similar rod, graduated from 17 to 30 feet, bolted to the south side of the same pier. The gage is read once each day by J. M. Deckert. Discharge measurements are made from the bridge, which spans the entire channel at ordinary stages. The initial point for soundings is at the south end of the bridge. The channel is straight for 200 feet above and below the station, and has a width of 225 feet at ordinary stages. Both banks are subject to overflow during high floods, the left bank being the lower of the two. The bed of the stream is composed of sand, clay, and silt, free from vegetation, and slightly shifting. The current is sluggish at low, and swift at high stages. There is but one channel at low stages and five or more during very high floods. Bench mark No. 1 is a cross cut in the capstone of the south bridge pier immediately above the upper gage, and is 32.14 feet above gage datum. Bench mark No. 2 is a cross near the top of the second stone from the ground in the northwest corner of the south abutment. Its elevation is 27.32 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Blue River near Manhattan, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per. sec.* | *Feet.* | *Sec.-feet.* |
| March 16 | W. G. Russell | 204 | 517 | 1.95 | 5.15 | 1,008 |
| April 27 | do | 234 | 4,076 | 4.33 | 18.15 | 17,650 |
| June 6 | M. C. Hinderlider | 270 | 2,401 | 4.21 | 13.46 | 10,120 |
| November 6 | W. G. Russell | 204 | 488 | 1.83 | 5.45 | 891 |

*Mean daily gage height, in feet, of Blue River near Manhattan, Kans., for 1904.*

| Day. | Jan.[a] | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.4 | 6.0 | 5.2 | 5.7 | 10.0 | 10.9 | 14.6 | 7.1 | 6.6 | 5.5 | 5.6 | 5.3 |
| 2 | 6.3 | 5.9 | 5.3 | 6.2 | 9.2 | 10.0 | 10.4 | 7.0 | 6.1 | 5.5 | 5.5 | 5.4 |
| 3 | 6.2 | 5.6 | 5.3 | 5.8 | 8.7 | 11.5 | 9.1 | 6.9 | 5.9 | 8.3 | 5.5 | 5.4 |
| 4 | 6.3 | 5.6 | 5.2 | 5.7 | 8.2 | 12.5 | 10.6 | 6.8 | 6.0 | 7.3 | 5.4 | 5.4 |
| 5 | 6.4 | 5.6 | 5.0 | 5.6 | 7.0 | 17.0 | 12.6 | 6.8 | 5.8 | 6.7 | 5.5 | 5.3 |
| 6 | 6.1 | 5.8 | 5.2 | 5.4 | 7.9 | 13.6 | 22.8 | 6.6 | 5.7 | 6.4 | 5.5 | 5.4 |
| 7 | 6.0 | 5.8 | 5.2 | 5.5 | 11.5 | 11.0 | 18.9 | 6.6 | 5.6 | 6.2 | 5.5 | 5.4 |
| 8 | 5.9 | 7.3 | 5.1 | 5.5 | 10.3 | 8.9 | 17.9 | 6.5 | 5.6 | 6.0 | 5.4 | 5.3 |
| 9 | 6.2 | [b]9.0 | 5.1 | 5.6 | 13.5 | 8.2 | 16.0 | 6.4 | 5.6 | 5.9 | 5.5 | 5.4 |
| 10 | 6.0 | 8.2 | 5.2 | 5.7 | 13.3 | 8.0 | 14.8 | 6.4 | 5.5 | 5.8 | 5.4 | 5.4 |
| 11 | 5.6 | 8.0 | 5.1 | 5.9 | 9.9 | 10.4 | 13.4 | 6.4 | 5.5 | 5.9 | 5.4 | 5.4 |
| 12 | 5.3 | 7.9 | 5.1 | 6.4 | 8.6 | 8.8 | 12.4 | 6.3 | 5.5 | 5.7 | 5.5 | 5.4 |
| 13 | 5.6 | 7.9 | 5.2 | 7.0 | 8.2 | 11.3 | 12.7 | 6.2 | 5.7 | 5.6 | 5.5 | 5.4 |
| 14 | 5.5 | 7.5 | 5.3 | 6.6 | 8.4 | 9.8 | 11.4 | 6.2 | 5.8 | 5.6 | 5.5 | 5.2 |
| 15 | 5.2 | 6.9 | 5.1 | 6.0 | 8.4 | 10.6 | 10.5 | 6.1 | 6.2 | 5.6 | 5.5 | 5.3 |
| 16 | 5.4 | 6.8 | 5.1 | 5.7 | 7.9 | 13.9 | 9.8 | 6.1 | 6.0 | 5.5 | 5.4 | 5.5 |
| 17 | 5.3 | 6.6 | 5.2 | 5.5 | 7.8 | 11.2 | 9.5 | 6.0 | 5.7 | 5.5 | 5.5 | 6.0 |
| 18 | 5.2 | 6.9 | 5.2 | 5.5 | 8.5 | 11.2 | 9.2 | 6.0 | 5.6 | 5.6 | 5.6 | 5.7 |
| 19 | 5.3 | 7.0 | 5.2 | 5.4 | 8.4 | 10.9 | 8.8 | 6.0 | 5.9 | 6.1 | 5.5 | 6.1 |
| 20 | 5.4 | 7.0 | 5.3 | 5.7 | 8.0 | 10.0 | 8.7 | 6.3 | 6.0 | 6.5 | 5.5 | 5.4 |
| 21 | 5.5 | 6.8 | 5.3 | 5.6 | 7.6 | 8.9 | 11.9 | 6.8 | 5.8 | 7.3 | 5.4 | 5.2 |
| 22 | 4.9 | 6.8 | 5.4 | 5.6 | 7.3 | 8.4 | 9.4 | 7.3 | 5.7 | 6.3 | 5.4 | 5.5 |
| 23 | 6.3 | 6.8 | 5.5 | 6.2 | 7.2 | 8.4 | 10.8 | 6.5 | 5.6 | 5.9 | 5.4 | 5.4 |
| 24 | 6.9 | 6.7 | 5.6 | 11.6 | 7.0 | 8.3 | 10.4 | 6.3 | 5.6 | 5.7 | 5.4 | 5.5 |
| 25 | 6.0 | [c]5.5 | 5.7 | 14.5 | 6.9 | 15.2 | 9.6 | 6.0 | 5.5 | 5.6 | 5.4 | 5.2 |
| 26 | 5.8 | 5.2 | 7.8 | 17.3 | 7.0 | 15.1 | 8.7 | 5.9 | 5.5 | 5.5 | 5.4 | 5.2 |
| 27 | 6.0 | 5.2 | 6.6 | 18.2 | 7.0 | 12.5 | 8.3 | 5.8 | 5.6 | 5.5 | 5.4 | [a]5.0 |
| 28 | 6.6 | 5.2 | 5.8 | 18.0 | 7.5 | 11.9 | 7.9 | 5.8 | 5.5 | 5.6 | 5.4 | [a]4.9 |
| 29 | 6.3 | 5.2 | 5.6 | 15.0 | 18.0 | 10.1 | 7.6 | 5.8 | 5.5 | 5.6 | 5.5 | [a]5.6 |
| 30 | 6.2 | ..... | 5.3 | 11.4 | 13.1 | 15.6 | 7.4 | 5.6 | 5.6 | 5.5 | 5.4 | [a]5.8 |
| 31 | 6.1 | ..... | 5.2 | ..... | 12.0 | ..... | 7.3 | 5.9 | ..... | 5.5 | ..... | [a]5.7 |

[a] River frozen greater portion of January and February; also December 27 to 31. Gage read to water surface in hole cut in ice.
[b] Ice jam.
[c] River clear of ice.

*Rating table for Blue River near Manhattan, Kans., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.60 | 680 | 6.40 | 1,540 | 8.20 | 2,850 | 12.50 | 7,940 |
| 4.70 | 710 | 6.50 | 1,600 | 8.40 | 3,020 | 13.00 | 8,690 |
| 4.80 | 740 | 6.60 | 1,660 | 8.60 | 3,190 | 13.50 | 9,440 |
| 4.90 | 770 | 6.70 | 1,725 | 8.80 | 3,370 | 14.00 | 10,200 |
| 5.00 | 800 | 6.80 | 1,790 | 9.00 | 3,550 | 14.50 | 10,990 |
| 5.10 | 840 | 6.90 | 1,855 | 9.20 | 3,740 | 15.00 | 11,800 |
| 5.20 | 880 | 7.00 | 1,920 | 9.40 | 3,940 | 15.50 | 12,640 |
| 5.30 | 930 | 7.10 | 1,990 | 9.60 | 4,150 | 16.00 | 13,490 |
| 5.40 | 980 | 7.20 | 2,060 | 9.80 | 4,370 | 16.50 | 14,340 |
| 5.50 | 1,030 | 7.30 | 2,130 | 10.00 | 4,600 | 17.00 | 15,190 |
| 5.60 | 1,080 | 7.40 | 2,200 | 10.20 | 4,830 | 17.50 | 16,040 |
| 5.70 | 1,135 | 7.50 | 2,275 | 10.40 | 5,070 | 18.00 | 16,900 |
| 5.80 | 1,190 | 7.60 | 2,350 | 10.60 | 5,310 | 19.00 | 18,720 |
| 5.90 | 1,245 | 7.70 | 2,430 | 10.80 | 5,560 | 20.00 | 20,700 |
| 6.00 | 1,300 | 7.80 | 2,510 | 11.00 | 5,810 | 21.00 | 22,700 |
| 6.10 | 1,360 | 7.90 | 2,595 | 11.50 | 6,470 | 22.00 | 24,700 |
| 6.20 | 1,420 | 8.00 | 2,680 | 12.00 | 7,190 | 23.00 | 26,750 |
| 6.30 | 1,480 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1902 to 1904, inclusive. It is fairly well defined to gage height, 26 feet.

*Estimated monthly discharge of Blue River near Manhattan, Kans., for 1904.*

[Drainage area, 9,490 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January [a] | ..... | ..... | ..... | ..... | ..... | ..... |
| February [a] | ..... | ..... | ..... | ..... | ..... | ..... |
| March | 2,510 | 800 | 996 | 61,240 | 0.105 | 0.121 |
| April | 17,250 | 980 | 3,778 | 224,800 | .398 | .444 |
| May | 16,900 | 1,855 | 4,155 | 255,500 | .438 | .505 |
| June | 15,190 | 2,680 | 6,337 | 377,100 | .668 | .745 |
| July | 26,340 | 2,130 | 6,991 | 429,900 | .737 | .850 |
| August | 2,130 | 1,080 | 1,508 | 92,720 | .159 | .183 |
| September | 1,660 | 1,030 | 1,160 | 69,020 | .122 | .136 |
| October | 2,935 | 1,030 | 1,310 | 80,550 | .138 | .159 |
| November | 1,080 | 980 | 1,010 | 60,100 | .106 | .118 |
| December [b] | 1,360 | 770 | 995 | 61,180 | .105 | .121 |
| The period | ..... | ..... | ..... | 1,712,000 | ..... | ..... |

[a] Frozen during January and February.
[b] Frozen December 27-31. Rating table assumed to apply correctly.

## MISCELLANEOUS MEASUREMENTS IN KANSAS RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Kansas River drainage basin in 1904:

*Miscellaneous measurements of streams tributary to Republican River.*

| Date. | Hydrographer. | Stream. | Locality. | Area. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | | *Sq. ft.* | *Ft. per sec.* | *Second-feet.* |
| June 4 | J. C. Stevens | Blue River | Wymore, Nebr | 489 | 1.36 | 664 |
| June 28 | do | do | do | 347 | 1.31 | 453 |
| July 14 | J. A. Green | do | Oak, Nebr | ..... | ..... | 517 |
| June 28 | do | Frenchman River | Sec. 18, T. 16, R. 40 | 8 | 1.25 | 10 |
| June 29 | do | do | Champion, Nebr | 26 | 1.73 | 45 |
| June 30 | do | do | Palisade, Nebr | 60 | 4.00 | 240 |
| July 11 | do | Medicine creek | Curtis, Nebr | ..... | ..... | 66 |
| July 7 | do | Millrace | Naponce, Nebr | 17 | 1.41 | 24 |
| July 7 | do | Naponce | do | 11 | 1.72 | 19 |
| June 5 | J. C. Stevens | Republican River | Warwick, Kans | 387 | 1.91 | 741 |
| July 1 | J. A. Green | do | McCook, Nebr | 201 | 2.20 | 443 |
| July 7 | do | do | Naponce, Nebr | 513 | 2.46 | 1,264 |
| July 6 | do | Sappa Creek | Stamford, Nebr | 38 | .95 | 36 |
| June 30 | do | Stinking Water Creek | Palisade, Nebr | 56 | 1.41 | 79 |
| June 30 | do | do | do | 49 | 1.29 | 63 |
| July 7 | do | Turkey Creek | Naponce, Nebr | 11 | .82 | .9 |

## MERAMEC RIVER DRAINAGE BASIN.

Meramec River rises in Dent County, Mo., flows northeast, and enters the Mississippi near St. Louis. This river drains a rugged, hilly, and comparatively thinly populated country. There are, however, numerous good sites for dams, and the United States Geological Survey is studying the river in connection with the possible water-power developments and for its possible use as a future water supply for the city of St. Louis.

The total drainage area of Meramec River is 3,619 square miles; at Eureka it is 3,497 square miles. The drainage area above Dry Fork is 340 square miles, while that of Dry Fork is 360 square miles.

### MERAMEC RIVER NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located about 600 feet below the mouth of Spring Branch and about 1 mile from the post-road between Meramec, Mo., and St. James, Mo. The nearest railroad station is St. James, Mo., 7 miles northwest of the station. The gage is a 2 by 6 inch pine stick, 10 feet long, graduated to feet and tenths by means of brass-headed nails. The gage is driven into the bed of the river and is nailed at the top to a leaning tree. The gage is read once each day by C. C. Smallwood. The equipment by means of which discharge measurements are made consists of a cable, boat, and tagged wire. The initial point for soundings has been taken at the tree to which the cable is attached on the left bank. The channel is straight for about 300 feet above the station and for 2,000 feet below. The current velocity is sufficient for accurate measurement except at low stages, when it becomes sluggish. Both banks are low, and at high water the river spreads over wide flats. The bed of the stream is shifting. The bench mark is a point on a bowlder on the left bank at the foot of the cliff near the mouth of Spring Branch. Its elevation is 10.44 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

*Discharge measurements of Meramec River near Meramec, Mo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| January 27 | F. W. Hanna | 132 | 349 | 1.12 | 3.33 | 390 |
| March 8 | do | 138 | 326 | .99 | 3.22 | 322 |
| April 13 | do | 145 | 579 | 1.01 | 4.05 | [a] 585 |
| June 14 | Hanna and Murphy | | | | 3.10 | [b] 281 |
| July 27 | F. W. Hanna | | | | 2.91 | [b] 193 |
| August 12 | do | | | | 2.80 | [b] 150 |
| September 28 | Hanna and Johnson | | | | 2.90 | [b] 185 |

[a] 70 feet upstream. [b] Sum of both branches.

*Mean daily gage height, in feet, of Meramec River near Meramec, Mo., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 3.0 | 3.4 | ..... | 4.2 | 3.4 | 4.4 | 2.9 | 2.9 | 3.0 | 2.75 | 2.75 |
| 2 | 2.5 | 3.0 | 3.4 | ..... | 4.2 | 3.3 | 4.0 | 2.9 | 2.9 | 3.5 | 2.75 | 2.75 |
| 3 | 2.4 | 2.9 | 3.5 | ..... | 4.1 | 3.4 | 3.8 | 2.9 | 2.9 | 3.4 | 2.75 | 2.75 |
| 4 | 2.4 | 2.8 | 3.3 | ..... | 4.1 | 3.9 | 3.9 | 2.85 | 2.9 | 3.3 | 2.75 | 2.75 |
| 5 | 2.4 | 2.8 | 3.2 | ..... | 4.2 | 4.8 | 3.9 | 2.85 | 2.9 | 3.1 | 2.75 | 2.75 |
| 6 | 2.4 | 2.8 | 3.5 | ..... | 4.2 | 4.2 | 3.8 | 2.85 | 2.9 | 3.0 | 2.75 | 2.75 |
| 7 | 2.4 | 3.1 | 3.5 | ..... | 4.2 | 3.9 | 3.6 | 2.8 | 2.8 | 3.0 | 2.75 | 2.75 |
| 8 | 2.4 | 2.9 | 3.3 | ..... | 4.1 | 3.8 | 3.4 | 2.8 | 2.8 | 3.0 | 2.75 | 2.75 |
| 9 | 2.4 | 2.9 | 3.2 | ..... | 4.4 | 3.5 | 3.4 | 2.8 | 2.8 | 2.9 | 2.75 | 2.75 |
| 10 | 2.4 | 2.8 | 3.1 | ..... | 4.0 | 3.4 | 3.3 | 2.8 | 2.8 | 2.9 | 2.75 | 2.75 |
| 11 | 2.4 | 2.7 | 3.1 | ..... | 3.9 | 3.4 | 3.3 | 2.8 | 2.8 | 2.9 | 2.75 | 2.75 |
| 12 | 2.4 | 2.7 | 3.2 | ..... | 3.7 | 3.2 | 3.3 | 2.8 | 2.8 | 2.8 | 2.75 | 2.75 |
| 13 | 2.4 | 2.7 | 3.2 | 4.05 | 3.6 | 3.2 | 3.2 | 2.8 | 2.8 | 2.8 | 2.8 | 2.75 |
| 14 | 2.4 | 2.7 | 3.1 | 4.0 | 3.6 | 3.2 | 3.2 | 2.8 | 2.8 | 2.8 | 2.8 | 2.75 |
| 15 | 2.4 | 2.7 | 3.1 | 3.9 | 3.5 | 3.2 | 3.1 | 2.8 | 2.8 | 2.8 | 2.8 | 2.75 |
| 16 | 2.4 | 2.6 | 3.1 | 3.8 | 3.4 | 3.3 | 3.0 | 2.8 | 2.8 | 2.8 | 2.8 | 2.75 |
| 17 | 4.0 | 2.6 | 3.1 | 3.7 | 3.3 | 3.3 | 3.3 | 2.9 | 2.8 | 2.8 | 2.8 | 2.75 |
| 18 | 4.0 | 2.6 | 3.2 | 3.7 | 3.5 | 3.4 | 3.2 | 3.0 | 2.8 | 2.8 | 2.8 | 2.75 |
| 19 | 4.0 | 2.6 | 3.2 | 3.6 | 3.7 | 3.7 | 3.2 | 3.1 | 2.9 | 2.8 | 2.8 | 2.75 |
| 20 | 4.0 | 2.6 | 3.0 | 3.5 | 3.7 | 3.9 | 3.1 | 3.2 | 2.9 | 2.8 | 2.8 | 2.75 |
| 21 | 6.8 | 2.6 | 3.0 | 3.1 | 3.6 | 4.5 | 3.1 | 3.3 | 2.9 | 2.8 | 2.8 | 2.75 |
| 22 | 5.5 | 2.6 | 3.1 | 3.0 | 3.6 | 4.2 | 3.0 | 3.4 | 2.8 | 2.8 | 2.8 | 2.75 |
| 23 | 4.8 | 3.0 | 4.1 | 3.0 | 3.5 | 4.0 | 3.0 | 3.6 | 2.8 | 2.8 | 2.8 | 2.75 |
| 24 | 4.4 | 3.4 | 4.1 | 8.4 | 3.4 | 3.3 | 2.9 | 3.5 | 2.8 | 2.8 | 2.8 | 2.75 |
| 25 | 4.0 | 3.5 | ..... | 8.0 | 3.4 | 3.3 | 2.9 | 3.2 | 2.9 | 2.8 | 2.8 | 2.75 |
| 26 | 3.4 | 3.4 | ..... | 6.5 | 3.3 | 3.3 | 2.9 | 3.1 | 2.9 | 2.8 | 2.8 | 2.75 |
| 27 | 3.3 | 3.2 | ..... | 6.1 | 3.6 | 6.1 | 2.9 | 3.1 | 2.9 | 2.8 | 2.8 | 2.75 |
| 28 | 3.2 | 3.1 | ..... | 5.0 | 3.5 | 7.0 | 2.9 | 3.0 | 2.9 | 2.75 | 2.8 | 2.75 |
| 29 | 3.1 | 3.2 | ..... | 4.9 | 3.4 | 5.3 | 2.9 | 3.0 | 2.9 | 2.75 | 2.8 | 2.75 |
| 30 | 3.0 | ..... | ..... | 4.7 | 3.9 | 4.9 | 2.9 | 2.9 | 2.9 | 2.75 | 2.75 | 2.75 |
| 31 | 3.0 | ..... | ..... | ..... | 3.8 | ..... | 2.9 | 2.9 | ..... | 2.75 | ..... | 2.75 |

## MERAMEC RIVER NEAR EUREKA, MO.

This station was established August 26, 1903, by F. W. Hanna. It is located at the highway bridge on the road between Crescent, Mo., and Eureka, Mo., about 1½ miles from Eureka, 2 miles below the mouth of Big River, and 2 miles above the 'Frisco Railroad bridge. The standard boxed chain gage is attached to the floor of the bridge. The length of the chain from the end of the weight to the marker is 42.46 feet. The gage is read once each day by Rhoda Hilderbran. Discharge measurements are made from the bridge to which the gage is attached. This is a two-span Pratt truss highway bridge, with a length between abutments of 450 feet. The initial point for soundings is the inner face of the right abutment on the upstream side. The channel is straight for about 250 feet above and 1,000 feet below the station. The current is never sluggish. The right bank is high and rocky and not subject to overflow. It is wooded above the high-water line. The left bank is somewhat lower and is composed of alluvial soil, and it also is wooded above the high-water line. The bed of the stream is composed of coarse gravel and stones. There is but one channel, broken by the center pier of the bridge. Bench mark No. 1 is a notch cut into the high rock cliff just below the bridge. It is marked by a painted cross and the letters "U. S. G. S." Its elevation is 38.26 feet above gage datum. Bench mark No. 2 is a red mark on the top of the downstream guard rail, just above the gage box. Its elevation is 42.56 feet above gage datum. Bench mark No. 3 is a painted cross, surrounded by the letters "U. S. G. S." on the lower wing of the left abutment. Its elevation is 36.29 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

*Discharge measurements of Meramec River near Eureka, Mo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| January 28 | F. W. Hanna | 245 | 1,309 | 1.64 | 7.90 | [a] 2,151 |
| March 9 | do | 170 | 554 | 2.93 | 4.30 | 1,620 |
| April 14 | do | 215 | 924 | 4.01 | 6.20 | 3,703 |
| April 28 | do | 444 | 8,154 | 4.59 | 24.95 | 37,470 |
| April 29 | do | 294 | 2,389 | 4.48 | 11.60 | 10,700 |
| June 15 | Murphy and Hanna | 163 | 529 | 3.01 | 4.37 | 1,605 |
| July 26 | F. W. Hanna | 253 | 416 | 2.38 | 3.67 | 992 |
| August 8 | do | 142 | 364 | 2.06 | 3.18 | 749 |
| October 5 | Johnson and Hanna | 209 | 804 | 3.67 | 5.77 | 2,947 |
| November 24 | F. W. Hanna | 143 | 313 | 1.89 | 3.08 | 591 |

[a] Backwater due to ice.

*Mean daily gage height, in feet, of Meramec River near Eureka, Mo., for 1904.*

| Day. | Jan.[a] | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.10 | ..... | ..... | 11.70 | 7.90 | 9.30 | 9.20 | 3.50 | 5.00 | 4.20 | 3.20 | 3.00 |
| 2 | 3.00 | ..... | ..... | 12.10 | 7.30 | 7.40 | 9.10 | 3.40 | 4.40 | 8.00 | 3.20 | 3.00 |
| 3 | 2.90 | ..... | ..... | 10.50 | 6.70 | 6.70 | 6.20 | 3.30 | 4.20 | 8.10 | 3.20 | 3.00 |
| 4 | 2.90 | ..... | ..... | 8.70 | 6.30 | 10.00 | 7.50 | 3.40 | 3.90 | 6.80 | 3.10 | 3.00 |
| 5 | 2.90 | ..... | ..... | 7.30 | 6.50 | 11.80 | 8.20 | 4.50 | 3.80 | 5.80 | 3.10 | 3.00 |
| 6 | 2.80 | ..... | ..... | 6.70 | 6.40 | 11.20 | 8.10 | 3.50 | 3.70 | 5.30 | 3.10 | 3.00 |
| 7 | 2.80 | ..... | ..... | 6.40 | 7.30 | 9.10 | 7.90 | 3.50 | 3.60 | 5.00 | 3.10 | 3.00 |
| 8 | 2.80 | ..... | ..... | 6.40 | 6.90 | 7.00 | 8.70 | 3.40 | 3.50 | 4.70 | 3.10 | 3.00 |
| 9 | 2.90 | ..... | 4.25 | 6.70 | 6.90 | 6.10 | 9.90 | 3.40 | 3.40 | 4.50 | 3.10 | 3.00 |
| 10 | 2.90 | ..... | 4.00 | 10.60 | 6.80 | 5.50 | 13.20 | 3.30 | 3.30 | 4.30 | 3.20 | 3.00 |
| 11 | 2.90 | ..... | 4.00 | 8.80 | 7.00 | 5.10 | 9.40 | 3.20 | 3.30 | 4.20 | 3.20 | 3.10 |
| 12 | 2.70 | ..... | 3.90 | 7.50 | 6.40 | 4.80 | 8.00 | 3.20 | 3.20 | 4.00 | 3.20 | 3.10 |
| 13 | 2.70 | ..... | 4.40 | 6.70 | 5.90 | 4.60 | 6.30 | 3.10 | 3.20 | 4.20 | 3.20 | 3.10 |
| 14 | 2.80 | ..... | 4.30 | 6.20 | 5.50 | 4.50 | 5.50 | 3.10 | 3.30 | 3.90 | 3.20 | 3.10 |
| 15 | 2.70 | ..... | 4.60 | 5.70 | 5.20 | 4.40 | 8.00 | 3.10 | 5.50 | 3.80 | 3.20 | 3.00 |
| 16 | 2.80 | ..... | 4.50 | 5.50 | 5.10 | 4.50 | 4.50 | 4.70 | 4.50 | 3.70 | 3.20 | 3.10 |
| 17 | 2.70 | ..... | 4.40 | 5.20 | 5.10 | 4.40 | 4.60 | 4.40 | 4.50 | 3.60 | 3.20 | 3.10 |
| 18 | 2.70 | ..... | 4.70 | 5.10 | 5.00 | 4.90 | 4.40 | 4.10 | 4.10 | 3.60 | 3.10 | 3.10 |
| 19 | 2.60 | ..... | 4.70 | 4.80 | 5.20 | 9.50 | 4.20 | 4.20 | 8.50 | 3.50 | 3.10 | 3.10 |
| 20 | 2.70 | ..... | 5.30 | 5.00 | 5.80 | 9.70 | 4.10 | 5.10 | 11.20 | 3.40 | 3.10 | 3.10 |
| 21 | [b]5.50 | ..... | 5.20 | 5.40 | 5.40 | 10.80 | 4.20 | 4.80 | 9.50 | 3.40 | 3.10 | 3.10 |
| 22 | 8.90 | ..... | 5.10 | 13.00 | 5.10 | 8.40 | 3.90 | 5.70 | 6.70 | 3.40 | 3.10 | 3.10 |
| 23 | 13.90 | ..... | 5.20 | 11.40 | 4.90 | 6.90 | 3.80 | 4.90 | 5.40 | 3.30 | 3.10 | 3.10 |
| 24 | 14.40 | ..... | 5.40 | 14.30 | 4.70 | 6.10 | 3.80 | 5.00 | 4.80 | 3.30 | 3.00 | 3.10 |
| 25 | 7.60 | ..... | 7.90 | 20.80 | 4.60 | 5.80 | 3.70 | 4.90 | 5.90 | 3.30 | 3.00 | 3.10 |
| 26 | 5.80 | ..... | 21.30 | 25.80 | 4.60 | 5.40 | 3.70 | 4.80 | 4.70 | 3.20 | 3.00 | 3.10 |
| 27 | 7.80 | ..... | 35.20 | 28.70 | 4.50 | 5.10 | 3.60 | 4.50 | 7.20 | 3.20 | 3.00 | 3.20 |
| 28 | 7.90 | ..... | 36.20 | 23.90 | 4.40 | 7.90 | 3.60 | 4.30 | 5.60 | 3.20 | 3.00 | 3.10 |
| 29 | ..... | ..... | 33.30 | 11.10 | 4.50 | 11.80 | 3.50 | 4.00 | 4.80 | 3.20 | 3.00 | 3.10 |
| 30 | ..... | ..... | 16.90 | 9.00 | 6.20 | 14.30 | 3.50 | 3.80 | 4.40 | 3.10 | 3.00 | 3.20 |
| 31 | 7.80 | ..... | 9.80 | ..... | 9.00 | ..... | 3.50 | 3.70 | ..... | 3.20 | ..... | 3.10 |

[a] Ice conditions uncertain during January. Rating table applied as for open channel, January 1 to 20.
[b] Backwater from ice January 21 to 30.

*Rating table for Meramec River near Eureka, Mo., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.60 | 460 | 4.40 | 1,700 | 6.40 | 3,810 | 10.00 | 8,330 |
| 2.70 | 490 | 4.50 | 1,790 | 6.60 | 4,030 | 10.50 | 9,040 |
| 2.80 | 530 | 4.60 | 1,880 | 6.80 | 4,250 | 11.00 | 9,790 |
| 2.90 | 580 | 4.70 | 1,980 | 7.00 | 4,470 | 11.50 | 10,540 |
| 3.00 | 640 | 4.80 | 2,080 | 7.20 | 4,710 | 12.00 | 11,340 |
| 3.10 | 710 | 4.90 | 2,180 | 7.40 | 4,950 | 12.50 | 12,190 |
| 3.20 | 780 | 5.00 | 2,280 | 7.60 | 5,190 | 13.00 | 13,090 |
| 3.30 | 850 | 5.10 | 2,380 | 7.80 | 5,430 | 13.50 | 14,040 |
| 3.40 | 920 | 5.20 | 2,490 | 8.00 | 5,670 | 14.00 | 15,040 |
| 3.50 | 990 | 5.30 | 2,600 | 8.20 | 5,920 | 15.00 | 17,050 |
| 3.60 | 1,060 | 5.40 | 2,710 | 8.40 | 6,180 | 16.00 | 19,100 |
| 3.70 | 1,130 | 5.50 | 2,820 | 8.60 | 6,440 | 17.00 | 21,100 |
| 3.80 | 1,200 | 5.60 | 2,930 | 8.80 | 6,700 | 18.00 | 23,100 |
| 3.90 | 1,280 | 5.70 | 3,040 | 9.00 | 6,960 | 19.00 | 25,100 |
| 4.00 | 1,360 | 5.80 | 3,150 | 9.20 | 7,220 | 20.00 | 27,120 |
| 4.10 | 1,440 | 5.90 | 3,260 | 9.40 | 7,490 | | |
| 4.20 | 1,520 | 6.00 | 3,370 | 9.60 | 7,770 | | |
| 4.30 | 1,610 | 6.20 | 3,590 | 9.80 | 8,050 | | |

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1903 and 1904. It is well defined between gage heights 2.8 feet and 6.2 feet. Two flood measurements at 11.6 and 25 feet gage height, respectively, define the curve above this limit. Above gage height 20 feet the rating curve is a tangent, the difference being 210 per tenth. The left bank overflows at the approximate gage height of 22.2 feet. It has been estimated that the overflow at 36.2 feet gage height was 7,000 second-feet or 50 second-feet per tenth gage height.

*Estimated monthly discharge of Meramec River near Eureka, Mo., for 1904.*

[Drainage area, 3,497 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 1–20 [a] | 710 | 460 | 544 | 21,580 | 0.156 | 0.116 |
| March 9–31 | 68,060 | 1,280 | 12,570 | 573,400 | 3.59 | 3.07 |
| April | 48,560 | 2,080 | 10,520 | 626,000 | 3.01 | 3.36 |
| May | 6,960 | 1,700 | 3,294 | 202,500 | .942 | 1.09 |
| June | 15,640 | 1,700 | 5,291 | 314,800 | 1.51 | 1.68 |
| July | 13,470 | 990 | 3,700 | 227,500 | 1.06 | 1.22 |
| August | 3,040 | 710 | 1,412 | 86,820 | .404 | .466 |
| September | 10,090 | 780 | 2,455 | 146,100 | .702 | .783 |
| October | 5,790 | 710 | 1,667 | 102,500 | .477 | .550 |
| November | 780 | 640 | 719 | 42,780 | .206 | .230 |
| December | 780 | 640 | 690 | 42,430 | .197 | .227 |
| The period | | | | 2,386,000 | | |

[a] Backwater from ice January 21 to 31.

## MERAMEC SPRING NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located on Spring Branch 500 feet from the spring, at a foot-bridge. This point is about 1 mile from the mouth of Spring Branch and 2 miles above the mouth of Dry Fork. The gage is a 2 by 3 inch pine rod 10 feet long. It is read once each day by C. C. Smallwood. Discharge measurements are made from the footbridge. The initial point for soundings is at the tree at the end of the foot-bridge on the right bank. The channel is straight for 50 feet above and for 500 feet below the station. Both banks are of clay and gravel and are about 6 feet high. They will overflow only at unusual flood stages. The bed of the stream is composed of gravel with some bowlders and is clean. The water is very swift, making accurate gage readings very difficult. The bench mark is located on the left corner stone of the breast wheel of the tail race just below the old breast wheel and is designated by a cross on the top surface of the stone. Its elevation above the zero of the gage is 4.68 feet.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

*Discharge measurements of Meramec Spring near Meramec, Mo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| January 27 | F. W. Hanna | 28 | 48 | 4.02 | 0.75 | 193 |
| March 8 | do | 28 | 43 | 4.28 | .65 | 184 |
| April 13 | do | 55 | 99 | 2.83 | 1.05 | 281 |
| June 14 | Murphy and Hanna | 54 | 76 | 2.26 | .60 | 172 |
| July 27 | F. W. Hanna | 54 | 76 | 1.79 | .48 | 136 |
| August 12 | do | 56 | 70 | 1.64 | .38 | 115 |
| September 28 | Hanna and Johnson | 55 | 68 | 1.57 | .37 | 107 |

NOTE.—The above measurements were made at different sections.

*Mean daily gage height, in feet, of Meramec Spring near Meramec, Mo., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.30 | 0.50 | 0.60 | 1.70 | 1.50 | 0.90 | 1.30 | 0.50 | 0.40 | 0.40 | 0.20 | 0.30 |
| 2 | .30 | .50 | .60 | 1.60 | 1.30 | .80 | 1.00 | .50 | .40 | .50 | .20 | .30 |
| 3 | .30 | .50 | .50 | 1.60 | 1.20 | .80 | 1.00 | .50 | .40 | .50 | .20 | .30 |
| 4 | .25 | .40 | .50 | 1.50 | 1.10 | 1.10 | 1.00 | .45 | .40 | .40 | .20 | .25 |
| 5 | .25 | .40 | .50 | 1.40 | 1.10 | 1.40 | 1.00 | .45 | .40 | .40 | .20 | .25 |
| 6 | .25 | .40 | .70 | 1.40 | 1.20 | 1.20 | .90 | .45 | .40 | .40 | .20 | .25 |
| 7 | .25 | .70 | .70 | 1.60 | 1.20 | 1.00 | .90 | .40 | .40 | .40 | .20 | .25 |
| 8 | .25 | .60 | .70 | 1.80 | 1.00 | .90 | .80 | .40 | .40 | .40 | .20 | .25 |
| 9 | .25 | .50 | .60 | 1.60 | 1.20 | .90 | .80 | .40 | .40 | .40 | .20 | .25 |
| 10 | .20 | .50 | .60 | 1.40 | 1.10 | .80 | .70 | .40 | .40 | .40 | .20 | .25 |
| 11 | .20 | .50 | .60 | 1.20 | 1.00 | .80 | .70 | .40 | .40 | .40 | .20 | .25 |
| 12 | .20 | .50 | .60 | 1.10 | 1.00 | .70 | .70 | .40 | .40 | .40 | .20 | .25 |
| 13 | .20 | .50 | .60 | 1.00 | .90 | .70 | .70 | .40 | .40 | .40 | .30 | .25 |
| 14 | .20 | .40 | .60 | 1.00 | .90 | .60 | .60 | .40 | .40 | .40 | .30 | .25 |
| 15 | .20 | .40 | .50 | .90 | .80 | .60 | .60 | .40 | .40 | .40 | .30 | .25 |
| 16 | .20 | .40 | .50 | .90 | .90 | .70 | .55 | .50 | .40 | .40 | .30 | .25 |
| 17 | 2.00 | .35 | .50 | .80 | .90 | .80 | .80 | .50 | .40 | .40 | .30 | .25 |
| 18 | 2.00 | .35 | .60 | 1.20 | .90 | .90 | .70 | .50 | .40 | .40 | .30 | .25 |
| 19 | 2.00 | .30 | .60 | 1.10 | .90 | .80 | .70 | .60 | .40 | .40 | .30 | .25 |
| 20 | 2.00 | .30 | .60 | .90 | .90 | .90 | .70 | .60 | .40 | .40 | .30 | .25 |
| 21 | 1.90 | .90 | .60 | .90 | .90 | .90 | .70 | .60 | .40 | .35 | .30 | .25 |
| 22 | 1.70 | .90 | .70 | .90 | .80 | .80 | .70 | .60 | .40 | .35 | .30 | .25 |
| 23 | 1.50 | .80 | .70 | 3.40 | .80 | .80 | .70 | .70 | .40 | .35 | .30 | .25 |
| 24 | 1.30 | .80 | .70 | 3.00 | .80 | .70 | .50 | .60 | .40 | .35 | .30 | .25 |
| 25 | 1.00 | .80 | 7.00 | 2.80 | .80 | .70 | .50 | .60 | .40 | .35 | .30 | .25 |
| 26 | .90 | .80 | 7.05 | 2.40 | .80 | .90 | .50 | .60 | .40 | .30 | .30 | .25 |
| 27 | .80 | .70 | 5.40 | 2.10 | .80 | 1.00 | .50 | .50 | .40 | .30 | .30 | .25 |
| 28 | .70 | .60 | 3.40 | 2.00 | .80 | 2.20 | .50 | .50 | .40 | .30 | .30 | .25 |
| 29 | .70 | .60 | 2.80 | 1.90 | .90 | 2.00 | .50 | .50 | .40 | .30 | .30 | .25 |
| 30 | .60 | ..... | 1.70 | ..... | 1.20 | 1.80 | .50 | .50 | .40 | .20 | .30 | .25 |
| 31 | .60 | ..... | 1.70 | ..... | 1.00 | ..... | .50 | .40 | ..... | .20 | ..... | .25 |

*Rating table for Meramec Spring near Meramec, Mo., from February 28, 1903, to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.30 | 94 | 0.80 | 212 | 1.60 | 494 | 2.50 | 836 |
| .35 | 104 | .85 | 227 | 1.70 | 532 | 2.60 | 874 |
| .40 | 114 | .90 | 242 | 1.80 | 570 | 2.70 | 912 |
| .45 | 125 | .95 | 258 | 1.90 | 608 | 2.80 | 950 |
| .50 | 136 | 1.00 | 275 | 2.00 | 646 | 2.90 | 988 |
| .55 | 148 | 1.10 | 310 | 2.10 | 684 | 3.00 | 1,026 |
| .60 | 160 | 1.20 | 346 | 2.20 | 722 | 3.10 | 1,064 |
| .65 | 172 | 1.30 | 382 | 2.30 | 760 | 3.20 | 1,102 |
| .70 | 185 | 1.40 | 418 | 2.40 | 798 | 3.30 | 1,140 |
| .75 | 198 | 1.50 | 456 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 19 discharge measurements made during 1903 and 1904. It is well defined between gage heights 0.30 foot and 1.75 feet. The table has been extended beyond these limits. Above gage height 1.4 feet the rating curve is a tangent, the difference being 38 per tenth.

*Estimated monthly discharge of Meramec Spring near Meramec, Mo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 646 | 76 | 236 | 14,510 |
| February | 242 | 94 | 150 | 8,628 |
| March | 2,565 | 136 | 454 | 27,920 |
| April | 1,178 | 212 | 473 | 28,140 |
| May | 456 | 212 | 273 | 16,790 |
| June | 722 | 160 | 273 | 16,240 |
| July | 382 | 136 | 194 | 11,930 |
| August | 185 | 114 | 135 | 8,301 |
| September | 114 | 114 | 114 | 6,783 |
| October | 136 | 76 | 109 | 6,702 |
| November | 94 | 76 | 86.8 | 5,165 |
| December | 94 | 85 | 85.9 | 5,282 |
| The year | 2,565 | 76 | 215 | 156,400 |

## ARKANSAS RIVER DRAINAGE BASIN.

Arkansas River rises in the central part of Colorado, flows south for about 70 miles, then east for 50 miles, increased by many small mountain streams. At Canyon City, Colo., it emerges from the Rocky Mountain front and takes a general easterly direction across the great plains of Colorado, where most of the water is diverted for irrigation. It flows east across Kansas to the center of the State, thence southeast through Indian Territory and Arkansas into Mississippi River about 25 miles north of Greenville, Miss. Throughout the mountainous area above Canyon City the discharge increases, but as soon as the river emerges onto the Great Plains the water is gradually diverted by lines of canals, so that by the time the Kansas line is reached the river is usually dry during the summer. Among its tributaries, Neosho (called the Grand in Indian Territory) and Verdigris rivers drain southeastern Kansas and flow south in nearly parallel courses, joining the Arkansas about 3 miles apart, west of Taleqnah, Ind. T. Walnut River is a small tributary from the north, flowing into the Arkansas at Arkansas City, Kans. The North Fork of Canadian River rises in the northeastern part of New Mexico and flows east through Oklahoma and Indian Territory into Canadian River about 40 miles above its mouth.

### ARKANSAS RIVER NEAR CANYON CITY, COLO.

This station is located at the suspension bridge at the Hot Springs Hotel. It is 1½ miles above the Strathmore Hotel and 1 mile above the State penitentiary, and a short distance below the mouth of Grape Creek at a point immediately below where the river leaves the mountains. Observations at this point were begun on April 17, 1889, the station being established here by Robert Robertson. The record has been maintained since that time, with occasional breaks due to absence or change of observer. The station is of special importance, being located at the mouth of the canyon and at a point practically above all of the irrigating ditches except the Canyon ditch (sometimes called the North Side ditch) and the South Canyon ditch (sometimes called the South Side ditch), both of which head above the station. During the irrigation season each of these ditches carries from 25 to 60 second feet of water according to the needs of the irrigators, and their discharge should be added to the discharge at the station in order to obtain the total run-off at the mouth of the canyon. No accurate records have been kept of the amount of water passing through these canals, although miscellaneous measurements have been made when measurements were made at the regular station. The estimated monthly discharges of the canyon do not include water taken out by these canals. This site

was used in 1888 for a gaging station by the State engineer of Colorado, but is favorable for obtaining only fairly accurate measurements.

The gage rod established by Mr. Robertson was of 2 by 6 inch timber, inclined, and attached to the crib of an old bridge on the south or right-hand side of the river, almost directly in front of the hotel. There were two bench marks: No. 1 on the top of a log of the crib—elevation, 10.01 feet above the datum; No. 2, in the cleft of a red bowlder at the foot of a charred stump 50 feet downstream and on the same side of the river—elevation, 9.60 feet.

On April 13, 1891, a third bench mark was established, this being a bedded rock 40 feet from the north end of the cable, toward Hot Springs Hotel, and 10 feet from the river bank. It is marked "B. M. No. 3, U. S. G. S.," and is 15.98 feet above the zero of the gage.

On October 4, 1895, it was found that the top of the gage had been broken off, necessitating its renewal for readings during high water. The channel was found to be filled with sand and gravel in front of the gage, requiring considerable work in order to make the water flow to the rod. It was decided, therefore, to put in a new gage where the stream could not deposit material. A point was chosen about 100 feet below the bridge, on the left bank, and a crib was built, anchored in place by rocks and bolts, the lower end of the gage being fastened to it. The upper end of the inclined portion was attached to a juniper tree. On December 27, 1895, the station was inspected, and it was found that readings had been made from the old rod, which, at the stage of water prevailing, recorded about 0.40 of a foot above the new rod on the opposite side of the river. When the water is high and extends with unbroken surface from bank to bank the readings are the same, but at low water the observations on the old rod are misleading, owing to the accumulation of sand and gravel in front of it.

On August 26, 1902, owing to the shifting of the channel, a new rod, consisting of 4 by 4 inch timber, was placed in an inclined position on the north or left bank of the river, at the site of the previous rod, just below the north end of the suspension bridge. The rod on this date read practically the same as the old rod.

A new gage was established September 2, 1903, by the State engineer. It is located on the right bank just below the bridge and consists of an inclined and a vertical section. The inclined section reads from zero to 7.3 feet. The vertical section reads from 7.3 to 12 feet. The present observer is Dr. J. L. Prentiss.

The measurements were at first made from a car suspended from a cable stretched across the river, the bridge from which measurements were originally made by the State engineer having been destroyed. Later a new suspension bridge was constructed in front of the hotel, necessitating the removal and replacement of the gage, and subsequent

measurements were made from this bridge, which, having a clear span, offers no obstruction to the current.

The initial point for soundings is the first post of the hand rail on the right bank. The channel is straight for 500 feet above and 300 feet below the station and has a width of about 135 feet. The current is very swift at high water and not too sluggish at low stages for accurate measurement. Both banks are high and rocky, and are not liable to overflow. The bed of the stream is composed of coarse gravel and small bowlders. It is not subject to change except on the right bank near the old gage, where a sand bar is formed at times of low water. The bed is rough, but is regular in shape. The bench mark in present use is a bedded bowlder 80 feet southeast of the south end of the suspension bridge, near the river bank. It is marked with a cross cut in the rock. Its elevation is 16.07 feet above the zero of the gage. This bench mark was checked December 16, 1903, and several times during 1904.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Arkansas River near Canyon City, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| April 1 | R. I. Meeker | 67 | 75 | 2.63 | 3.50 | 197 |
| April 22 | do | 87 | 147 | 4.24 | 4.20 | 623 |
| May 20 | do | 95 | 225 | 5.88 | 5.12 | 1,322 |
| May 21 [a] | do | 67 | 234 | 6.08 | 5.20 | 1,449 |
| June 25 | do | 92 | 202 | 5.53 | 4.90 | 1,127 |
| August 3 | do | 88 | 155 | 4.05 | 4.30 | 628 |
| September 2 | do | 90 | 165 | 4.98 | 4.40 | 821 |

[a] Measured from Ninth Street Bridge.

*Mean daily gage height, in feet, of Arkansas River near Canyon City, Colo., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.75 | 3.60 | 3.55 | 3.45 | 3.55 | 5.65 | 5.30 | 4.25 | 4.35 | 4.70 | 3.80 | 3.60 |
| 2 | 3.80 | 3.70 | 3.55 | 3.50 | 3.90 | 5.65 | 5.30 | 4.40 | 4.35 | 4.45 | 3.80 | 3.60 |
| 3 | 3.65 | 3.60 | 3.50 | 3.50 | 4.00 | 5.40 | 5.20 | 4.30 | 4.35 | 4.30 | 3.80 | 3.65 |
| 4 | 3.65 | 3.55 | 3.50 | 3.50 | 3.80 | 5.35 | 5.00 | 4.20 | 4.25 | 4.20 | 3.78 | 3.70 |
| 5 | 3.65 | 3.65 | 3.45 | 3.55 | 3.70 | 5.15 | 5.00 | 4.20 | 4.20 | 4.20 | 3.71 | 3.70 |
| 6 | 3.65 | 3.65 | 3.45 | 3.70 | 3.70 | 4.95 | 4.90 | 4.20 | 4.30 | 4.10 | 3.70 | 3.70 |
| 7 | 3.65 | 3.60 | 3.40 | 3.55 | 3.80 | 4.80 | 4.80 | 4.20 | 4.25 | 4.20 | 3.70 | 3.70 |
| 8 | 3.65 | 3.55 | 3.40 | 3.50 | 3.95 | 4.85 | 4.75 | 4.60 | 4.15 | 4.25 | 3.70 | 3.70 |
| 9 | 3.75 | 3.50 | 3.40 | 3.40 | 4.30 | 5.15 | 4.65 | 4.35 | 4.00 | 4.30 | 3.70 | 3.70 |
| 10 | 3.70 | 3.60 | 3.40 | 3.40 | 4.35 | 5.20 | 4.85 | 4.25 | 3.90 | 4.40 | 3.70 | 3.80 |
| 11 | 3.70 | 3.50 | 3.40 | 3.45 | 4.30 | 4.95 | 4.85 | 4.15 | 3.80 | 4.30 | 3.75 | 3.80 |
| 12 | 3.70 | 3.70 | 3.40 | 3.55 | 4.35 | 5.30 | 4.85 | 4.20 | 3.80 | 4.25 | 3.80 | 3.80 |
| 13 | 3.70 | 3.75 | 3.40 | 3.65 | 4.60 | 5.50 | 4.85 | 4.20 | 3.70 | 4.30 | 3.70 | 3.80 |
| 14 | 3.70 | 3.75 | 3.38 | 3.70 | 4.95 | 5.50 | 4.85 | 4.40 | 3.70 | 4.25 | 3.70 | 3.70 |
| 15 | 3.80 | 3.75 | 3.92 | 4.17 | 4.95 | 5.35 | 4.80 | 4.70 | 3.70 | 4.20 | 3.70 | 3.70 |
| 16 | 3.65 | 3.70 | 4.00 | 4.20 | 4.80 | 5.35 | 4.70 | 5.32 | 3.70 | 4.20 | 3.70 | 3.70 |
| 17 | 3.70 | 3.75 | 3.45 | 4.20 | 4.75 | 5.25 | 4.70 | 5.32 | 3.80 | 4.15 | 3.70 | 3.60 |
| 18 | 3.75 | 3.80 | 3.40 | 4.25 | 4.65 | 5.30 | 4.70 | 4.60 | 3.80 | 4.10 | 3.70 | 3.70 |
| 19 | 3.70 | 3.75 | 3.40 | 4.35 | 4.75 | 5.20 | 4.75 | 4.65 | 3.80 | 4.10 | 3.65 | 3.60 |
| 20 | 3.60 | 3.75 | 3.40 | 4.30 | 5.00 | 5.30 | 4.70 | 4.50 | 3.80 | 4.05 | 3.60 | 3.60 |
| 21 | 3.55 | 3.75 | 3.50 | 4.30 | 5.15 | 5.25 | 4.65 | 4.30 | 3.70 | 4.10 | 3.60 | 3.65 |
| 22 | 3.50 | 3.85 | 3.45 | 4.20 | 5.15 | 5.30 | 4.60 | 4.20 | 3.75 | 4.10 | 3.60 | 3.70 |
| 23 | 3.40 | 3.90 | 3.40 | 4.10 | 5.15 | 5.15 | 4.60 | 4.25 | 3.80 | 4.10 | 3.60 | 3.70 |
| 24 | 3.55 | 3.85 | 3.35 | 4.10 | 5.75 | 5.20 | 4.40 | 4.20 | 3.80 | 4.00 | 3.60 | 3.70 |
| 25 | 3.60 | 3.80 | 3.30 | 4.05 | 5.85 | 4.95 | 4.50 | 4.20 | 3.75 | 4.00 | 3.60 | 3.70 |
| 26 | 3.60 | 3.75 | 3.30 | 3.55 | 5.35 | 4.95 | 4.45 | 4.10 | 3.70 | 3.95 | 3.60 | 3.70 |
| 27 | 3.60 | 3.65 | 3.30 | 3.50 | 5.10 | 4.90 | 4.20 | 4.15 | 3.70 | 3.90 | 3.60 | 3.60 |
| 28 | 3.45 | 3.60 | 3.30 | 3.55 | 5.15 | 4.85 | 4.20 | 4.20 | 3.75 | 3.90 | 3.60 | 3.60 |
| 29 | 3.50 | 3.60 | 3.30 | 3.60 | 5.10 | 4.95 | 4.20 | 4.30 | 3.80 | 3.90 | 3.60 | 3.60 |
| 30 | 3.55 | ..... | 3.30 | 3.60 | 5.15 | 5.20 | 4.30 | 4.40 | 4.90 | 3.80 | 3.60 | 3.70 |
| 31 | 3.55 | ..... | 3.40 | ..... | 5.65 | ..... | 4.30 | 4.40 | ..... | 3.80 | ..... | 3.70 |

*Rating table for Arkansas River near Canyon City, Colo., from January to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.30 | 119 | 3.90 | 406 | 4.60 | 880 | 5.30 | 1,490 |
| 3.35 | 136 | 4.00 | 465 | 4.70 | 960 | 5.40 | 1,590 |
| 3.40 | 155 | 4.10 | 529 | 4.80 | 1,040 | 5.50 | 1,690 |
| 3.45 | 175 | 4.20 | 593 | 4.90 | 1,122 | 5.60 | 1,795 |
| 3.50 | 197 | 4.30 | 660 | 5.00 | 1,210 | 5.70 | 1,905 |
| 3.60 | 243 | 4.40 | 730 | 5.10 | 1,300 | 5.80 | 2,015 |
| 3.70 | 295 | 4.50 | 802 | 5.20 | 1,392 | 5.90 | 2,125 |
| 3.80 | 349 | | | | | | |

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1903 and 1904 and is well defined.

*Estimated monthly discharge of Arkansas River near Canyon City, Colo., for 1904.*

[Drainage area, 3,060 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 349 | 155 | 264 | 16,230 | 0.086 | 0.099 |
| February | 406 | 197 | 290 | 16,680 | .095 | .102 |
| March | 465 | 119 | 176 | 10,820 | .058 | .067 |
| April | 695 | 155 | 355 | 21,120 | .116 | .129 |
| May | 2,070 | 220 | 989 | 60,810 | .323 | .372 |
| June | 1,850 | 1,040 | 1,396 | 83,070 | .456 | .509 |
| July | 1,490 | 593 | 975 | 59,950 | .319 | .368 |
| August | 1,510 | 529 | 726 | 44,640 | .237 | .273 |
| September | 1,122 | 295 | 444 | 26,420 | .145 | .162 |
| October | 960 | 349 | 563 | 34,620 | .184 | .212 |
| November | 349 | 243 | 285 | 16,960 | .093 | .104 |
| December | 349 | 243 | 287 | 17,650 | .094 | .108 |
| The year | 2,070 | 119 | 562 | 409,000 | .184 | 2.50 |

## ARKANSAS RIVER AT PUEBLO, COLO.

This station is an important one, being located near the head of the principal irrigated portion of the valley. Only one ditch of importance is taken out above it in the Pueblo district, although considerable water is used in the ditches in the neighborhood of Canyon City, which is in another water district. It is upon the gagings made at this point that the water superintendents and commissioners depend for distribution of water to ditches below.

The station was established in September, 1894, by A. P. Davis. Originally there were two gage rods. The main gage was located at the Santa Fe Avenue Bridge, and consisted of a vertical 6 by 6 inch timber and a 1 by 6 inch scale bolted to the abutment of the Denver and Rio Grande Railroad bridge on the left-hand side of the river, graduated to tenths of a foot. There was also a short vertical rod for extreme low water spiked to a pile about 20 feet out in the stream, reading the same as the main gage. The 12-foot mark of this gage was opposite the top of the large capstone. The rod at Victoria Avenue Bridge consisted of inclined 4 by 4 inch timbers fastened to posts set in the right bank of the stream, graduated to vertical tenths of a foot, the space between the marks being 0.242 of a foot. This rod was placed in June, 1895, for the purpose of noting the change in the slope of the water surface. The rods were read until July 10,

1898, when, on account of the shifting of the bed of the river, they were abandoned and a new gage was installed on the east side of the Main Street Bridge. From this bridge all the discharge measurements were made until the season of 1902.

Readings were made at Main Street Bridge until March 3, 1900, when, owing to the scouring of the channel, it became necessary to replace the gage by one about 60 feet below the south end of the Union Avenue Bridge. This gage was a 2 by 6 inch vertical timber, bolted, like the former rod, to the masonry wall and graduated to feet and tenths. On June 13, 1900, this rod was connected with a bench mark on the coping at the northwest corner of the Union Avenue Bridge, which was found to be 19.79 feet above the zero of the rod. In March, 1902, another rod exactly similar to the one last mentioned was bolted in a vertical position to the masonry wall on the right-hand side of the river about 30 feet above the south end of the Union Avenue Bridge. All gage heights up to July 14, 1902, were taken from the rod just below the Union Avenue Bridge. After July 14, 1902, the readings were taken from the rod above the bridge, the graduations on the former rod being too dim to be read at low water. A difference of 0.2 of a foot existed between the two rods when the new one was set, the new rod reading 0.2 of a foot higher than the old one. In all the discharge measurements made during 1902 the gage height was taken from the new rod above the Union Avenue Bridge. The gage is read twice each day by W. A. Stebbins. Discharge measurements are made from the Union Avenue Bridge, which is marked every 10 feet on the downstream side. The initial point for soundings is the edge of the masonry retaining wall on the right side of the channel at the southwest end of the bridge. The channel is straight for 500 feet above and 800 feet below the bridge, has a width of 150 feet, and is confined by high masonry walls. The bed is composed of sand and gravel, and there is little change in the bed of the channel, except that it fills during low water and scours out during high water. The flow of the stream is rapid, but not too swift for accurate measurements.

A bench mark was established March 31, 1904. It is the surface of the capstone of masonry wall to which gage is bolted and directly above rod. Its elevation is 18.13 feet above the zero of rod.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurements of Arkansas River at Pueblo, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| February 22 [a] | R. I. Meeker | 89 | 121 | 2.21 | 2.00 | 267 |
| March 31 [a] | do | 70 | 74 | 1.76 | 1.70 | 130 |
| April 22 [b] | do | 125 | 219 | 3.87 | 2.78 | 848 |
| May 20 [b] | do | 149 | 246 | 5.78 | 3.20 | 1,422 |
| June 24 [b] | do | 154 | 262 | 5.25 | 3.30 | 1,376 |
| August 2 [b] | do | 155 | 222 | 4.44 | 2.92 | 985 |
| August 2 [b] | G. B. Monk | 155 | 222 | 4.81 | 2.92 | 1,067 |
| August 31 [b] | R. I. Meeker | 144 | 152 | 4.25 | 2.62 | 646 |

[a] Measured at Victoria Avenue Bridge. [b] Measured at Main Street Bridge.

*Mean daily gage height, in feet, of Arkansas River at Pueblo, Colo., for 1904.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.82 | 2.00 | 3.75 | 3.40 | 2.55 | 2.90 | 3.40 | 2.50 | 2.20 |
| 2 | 1.90 | 3.55 | 3.85 | 3.40 | 2.95 | 2.95 | 3.05 | 2.50 | 2.20 |
| 3 | 1.82 | 4.25 | 3.65 | 3.10 | 2.70 | 3.05 | 2.85 | 2.45 | 2.20 |
| 4 | 1.85 | 2.55 | 3.60 | 3.05 | 2.65 | 2.65 | 2.85 | 2.35 | 2.25 |
| 5 | 1.88 | 2.20 | 3.05 | 3.05 | 2.50 | 2.60 | 2.75 | 2.35 | 2.25 |
| 6 | 1.88 | 2.50 | 3.10 | 3.05 | 2.45 | 2.60 | 2.70 | 2.35 | 2.25 |
| 7 | 1.98 | 2.65 | 2.90 | 2.80 | 2.45 | 2.75 | 2.65 | 2.35 | 2.25 |
| 8 | 1.88 | 2.75 | 3.45 | 3.05 | 2.80 | 2.70 | 2.80 | 2.35 | 2.25 |
| 9 | 1.78 | 2.90 | 4.10 | 2.65 | 2.45 | 2.60 | 2.90 | 2.35 | 2.30 |
| 10 | 1.65 | 2.95 | 3.50 | 2.85 | 2.35 | 2.45 | 2.80 | 2.35 | 2.30 |
| 11 | 1.60 | 3.05 | 3.20 | 2.90 | 2.45 | 2.45 | 2.85 | 2.35 | 2.35 |
| 12 | 1.65 | 2.95 | 3.50 | 2.80 | 2.45 | 2.45 | 2.85 | 2.35 | 2.35 |
| 13 | 1.75 | 3.05 | 3.35 | 2.80 | 2.45 | 2.35 | 2.85 | 2.45 | 2.35 |
| 14 | 1.88 | 3.10 | 4.05 | 2.75 | 3.00 | 2.35 | 2.85 | 2.40 | 2.30 |
| 15 | 2.18 | 3.40 | 4.75 | 2.78 | 3.60 | 2.25 | 2.80 | 2.35 | 2.30 |
| 16 | 2.55 | 3.05 | 4.40 | 2.75 | 2.85 | 2.25 | 2.75 | 2.30 | 2.30 |
| 17 | 2.50 | 2.95 | 4.00 | 2.70 | 3.10 | 2.15 | 2.75 | 2.30 | 2.30 |
| 18 | 2.55 | 2.92 | 3.80 | 2.75 | 3.55 | 2.25 | 2.75 | 2.35 | 2.30 |
| 19 | 2.50 | 2.92 | 3.60 | 3.15 | 3.50 | 2.25 | 2.65 | 2.25 | 2.30 |
| 20 | 2.65 | 3.35 | 3.40 | 2.75 | 3.10 | 2.25 | 2.65 | 2.35 | 2.30 |
| 21 | 2.60 | 3.32 | 4.10 | 2.85 | 2.70 | 2.25 | 2.65 | 2.25 | 2.30 |
| 22 | 2.60 | 3.45 | 3.55 | 2.80 | 2.65 | 2.25 | 2.65 | 2.25 | 2.30 |
| 23 | 2.52 | 3.28 | 3.60 | 2.85 | 2.75 | 2.25 | 2.65 | 2.25 | 2.30 |
| 24 | 2.52 | 3.78 | 3.25 | 4.25 | 2.65 | 2.25 | 2.60 | 2.25 | 2.30 |
| 25 | 2.50 | 4.05 | 3.25 | 3.15 | 2.75 | 2.25 | 2.60 | 2.25 | 2.30 |
| 26 | 2.40 | 3.75 | 3.15 | 2.55 | 2.75 | 2.25 | 2.60 | 2.20 | 2.30 |
| 27 | 1.95 | 3.45 | 3.15 | 2.45 | 2.85 | 2.30 | 2.60 | 2.20 | 2.20 |
| 28 | 1.90 | 3.40 | 3.10 | 2.55 | 2.70 | 2.30 | 2.60 | 2.20 | 2.25 |
| 29 | 1.80 | 3.20 | 3.05 | 2.55 | 2.75 | 2.45 | 2.55 | 2.20 | [a] 4.15 |
| 30 | 1.95 | 3.15 | 3.05 | 2.55 | 3.25 | 3.05 | 2.55 | 2.20 | 4.45 |
| 31 | ..... | 3.50 | ..... | 2.70 | 2.85 | ..... | 2.50 | ..... | 4.45 |

[a] Ice jam below station.

*Rating table for Arkansas River at Pueblo, Colo., from April 1, to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.60 | 95 | 2.10 | 315 | 3.00 | 1,060 | 3.90 | 2,150 |
| 1.65 | 110 | 2.20 | 375 | 3.10 | 1,170 | 4.00 | 2,280 |
| 1.70 | 130 | 2.30 | 440 | 3.20 | 1,280 | 4.10 | 2,410 |
| 1.75 | 150 | 2.40 | 510 | 3.30 | 1,400 | 4.20 | 2,540 |
| 1.80 | 170 | 2.50 | 590 | 3.40 | 1,520 | 4.30 | 2,680 |
| 1.85 | 190 | 2.60 | 670 | 3.50 | 1,640 | 4.40 | 2,820 |
| 1.90 | 215 | 2.70 | 760 | 3.60 | 1,760 | 4.50 | 2,960 |
| 1.95 | 240 | 2.80 | 860 | 3.70 | 1,890 | 4.60 | 3,100 |
| 2.00 | 265 | 2.90 | 960 | 3.80 | 2,020 | 4.70 | 3,240 |

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904 and one high-water measurement made in 1903. It is well defined between gage heights 1.60 feet and 3.30 feet.

*Estimated monthly discharge of Arkansas River at Pueblo, Colo., for 1904.*

[Drainage area, 4,600 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 715 | 95 | 350 | 20,830 | 0.076 | 0.085 |
| May | 2,610 | 265 | 1,260 | 77,470 | .274 | .316 |
| June | 3,310 | 960 | 1,711 | 101,800 | .372 | .415 |
| July | 2,610 | 550 | 976 | 60,010 | .212 | .244 |
| August | 1,760 | 475 | 874 | 53,740 | .190 | .219 |
| September | 1,115 | 345 | 578 | 34,390 | .126 | .141 |
| October | 1,520 | 590 | 810 | 49,800 | .176 | .203 |
| November | 590 | 375 | 456 | 27,130 | .099 | .110 |
| December [a] | 475 | 375 | 424 | 26,070 | .092 | .106 |
| The period | | | | 451,200 | | |

[a] Discharge estimated December 29–31, as river was gorged with ice.

## ARKANSAS RIVER NEAR SYRACUSE, KANS.

This station, established August 21, 1902, by W. G. Russell, is located on the highway bridge 1 mile south of Syracuse, Kans. The gage is a plain staff graduated to feet and tenths, and fastened to the east pile of the bent 283 feet south of the north end of the bridge. On November 12, 1904, this gage was moved by W. G. Russell to the down-stream pile of bent, 158 feet from the initial point as the water had left the gage. The initial point for soundings is on the left bank. The channel above and below the station is straight and the water is sluggish. The right bank is low and liable to overflow; the left bank is high, and the bed of the stream is sandy and shifting. The bench mark is on the top of the east end of the first sill at the north end of the bridge. Its elevation is 11.52 feet above the zero of the gage. The gage is read daily by M. Adaline Stewart.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Arkansas River near Syracuse, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 7 | W. G. Russell | 232 | 368 | 2.33 | 3.60 | 858 |
| May 21 | do | 57 | 39 | .97 | 1.90 | 38 |
| May 22 | do | 524 | 1,064 | 5.25 | 4.70 | 5,582 |
| May 23 | do | 581 | 1,643 | 4.27 | 5.15 | 7,009 |
| May 23 | do | 575 | 1,435 | 4.01 | 4.80 | 5,750 |
| June 15 | do | | 2,060 | 4.51 | 5.50 | 9,291 |
| November 12 | do | 85 | 85 | 2.19 | 1.40 | 186 |

*Mean daily gage height, in feet, of Arkansas River near Syracuse, Kans., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.10 | 2.40 | 1.90 | 1.90 | 1.70 | 3.00 | 2.90 | 3.75 | 2.90 | 6.75 | 2.40 | 1.20 |
| 2 | 2.10 | 2.40 | 1.90 | 1.90 | 1.80 | 2.80 | 2.80 | 4.65 | 3.10 | 7.00 | 2.20 | 1.20 |
| 3 | 2.10 | 2.40 | 1.90 | 1.90 | 1.80 | 2.60 | 2.70 | 4.40 | 3.00 | 5.70 | 2.20 | 1.20 |
| 4 | 2.20 | 2.40 | 1.90 | 1.90 | 6.20 | 2.60 | 2.70 | 3.50 | 4.50 | 4.70 | 2.10 | 1.20 |
| 5 | 2.40 | 2.40 | 1.90 | 1.90 | 4.50 | 2.50 | 2.80 | 3.40 | 4.00 | 3.80 | 2.00 | 1.20 |
| 6 | 2.40 | 2.60 | 1.90 | 1.80 | 3.90 | 2.50 | 3.50 | 3.20 | 3.50 | 3.70 | 1.80 | 1.20 |
| 7 | 2.40 | 2.50 | 1.90 | 1.80 | 3.80 | 3.10 | 3.50 | 4.15 | 3.10 | 3.70 | 1.70 | 1.20 |
| 8 | 2.40 | 2.50 | 1.90 | 1.80 | 3.60 | 3.40 | 3.10 | 4.30 | 2.90 | 3.50 | 1.60 | 1.40 |
| 9 | 2.40 | 2.50 | 1.90 | 1.90 | 3.50 | 3.40 | 3.40 | 4.10 | 2.80 | 3.50 | 1.60 | 1.40 |
| 10 | 2.40 | 2.60 | 1.90 | 1.90 | 3.20 | 6.15 | 3.80 | 3.50 | 2.70 | 3.50 | 1.50 | 1.80 |
| 11 | 2.40 | 2.60 | 1.90 | 1.80 | 2.50 | 6.00 | 3.80 | 2.90 | 2.50 | 3.40 | 1.50 | 1.90 |
| 12 | 2.50 | 2.70 | 1.90 | 1.80 | 2.30 | 5.00 | 4.60 | 3.10 | 2.50 | 3.40 | 1.40 | 1.80 |
| 13 | 2.50 | 2.70 | 1.90 | 1.80 | 2.30 | 5.50 | 3.80 | 3.40 | 2.40 | 3.40 | 1.40 | 1.50 |
| 14 | 2.50 | 2.70 | 1.90 | 1.80 | 2.30 | 6.20 | 3.50 | 3.40 | 2.40 | 3.40 | 1.30 | 1.40 |
| 15 | 2.50 | 2.60 | 1.90 | 1.70 | 2.30 | 5.50 | 3.30 | 3.30 | 2.40 | 3.40 | 1.30 | 2.50 |
| 16 | 2.60 | 2.60 | 1.90 | 1.70 | 2.30 | 4.50 | 2.80 | 3.20 | 2.30 | 3.30 | 1.30 | 2.50 |
| 17 | 2.60 | 2.50 | 1.90 | 1.70 | 2.30 | 4.20 | 2.80 | 3.20 | 2.30 | 3.30 | 1.30 | 2.50 |
| 18 | 2.60 | 2.40 | 1.90 | 1.70 | 2.30 | 4.00 | 2.80 | 3.00 | 2.30 | 3.30 | 1.30 | 2.30 |
| 19 | 2.60 | 2.40 | 1.90 | 1.70 | 1.90 | 3.70 | 2.60 | 5.75 | 2.20 | 3.10 | 1.30 | 2.00 |
| 20 | 2.50 | 2.40 | 1.90 | 1.70 | 1.90 | 3.60 | 2.50 | 5.25 | 2.20 | 3.10 | 1.30 | 1.50 |
| 21 | 2.40 | 2.40 | 1.90 | 1.70 | 1.85 | 3.50 | 2.50 | 4.60 | 2.20 | 3.10 | 1.30 | 1.50 |
| 22 | 2.40 | 2.30 | 1.90 | 1.70 | 5.00 | 5.75 | 2.40 | 3.50 | 2.10 | 3.00 | 1.20 | 1.50 |
| 23 | 2.40 | 2.30 | 1.80 | 1.70 | 4.95 | 5.00 | 2.80 | 3.30 | 2.10 | 3.00 | 1.20 | 1.60 |
| 24 | 2.30 | 2.00 | 1.80 | 1.70 | 4.30 | 3.80 | 2.80 | 3.20 | 2.10 | 3.00 | 1.20 | 1.60 |
| 25 | 2.30 | 2.00 | 1.80 | 1.70 | 4.10 | 3.50 | 2.80 | 3.10 | 2.10 | 2.80 | 1.20 | 1.50 |
| 26 | 2.40 | 2.00 | 1.80 | 1.70 | 3.80 | 3.40 | 3.90 | 2.90 | 2.10 | 2.80 | 1.20 | 1.50 |
| 27 | 2.40 | 1.90 | 1.80 | 1.70 | 3.50 | 3.40 | 3.90 | 2.80 | 2.10 | 2.70 | 1.20 | 1.30 |
| 28 | 2.50 | 1.90 | 1.80 | 1.70 | 3.45 | 3.20 | 3.90 | 2.90 | 2.10 | 2.70 | 1.20 | 1.30 |
| 29 | 2.40 | 1.90 | 1.80 | 1.70 | 3.30 | 3.20 | 3.40 | 2.70 | 2.20 | 2.50 | 1.20 | 1.30 |
| 30 | 2.40 | ..... | 1.80 | 1.75 | 3.10 | 3.00 | 3.10 | 2.90 | 2.30 | 2.50 | 1.20 | 1.20 |
| 31 | 2.40 | ..... | 1.90 | ..... | 3.00 | ..... | 2.80 | 2.70 | ..... | 2.50 | ..... | 1.20 |

## ARKANSAS RIVER NEAR DODGE, KANS.

This station was established November 28, 1902, by W. G. Russell, and is located one-fourth mile south of Dodge, on the highway bridge. The gage is a plain staff graduated to feet and tenths and nailed to the upstream pile of the twelfth bent at the north end of the bridge. After the flood of October 1–3, 1904, the water left this gage and it was moved to the upstream pile of a bent 337 feet from the north end of the bridge and tested with a Wye level October 19, 1904, and found correct. The initial point for soundings is on the left bank. The channel both above and below the station is straight for about 100 feet. Both banks are low and liable to overflow. The bed of the stream is sandy and shifting. The gage is read once each day by Alexander Alter. Bench mark No. 1 is the top of the east end of the cap at the north end of the bridge; elevation 100.00 feet. Bench mark No. 2 is the top of the east end of the cap at the abutment of the south end of the bridge; elevation, 100.27 feet.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Arkansas River near Dodge, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 26 | W. G. Russell | 16 | 4 | 1.00 | 1.00 | 4 |
| May 5 | do | 425 | 826 | 3.77 | 3.10 | 3,110 |
| May 6 | do | 415 | 699 | 2.78 | 2.80 | 1,947 |
| May 24 | do | 415 | 750 | 4.04 | 3.05 | 3,031 |
| May 24 | do | 426 | 905 | 3.91 | 3.25 | 3,541 |
| May 25 | do | 416 | 792 | 3.11 | 3.00 | 2,461 |
| June 14 | do | 556 | 1,165 | 3.36 | 3.55 | 3,908 |
| June 14 | do | 558 | 1,864 | 4.35 | 4.60 | 8,102 |
| August 20 | do | 185 | 78 | 1.59 | 1.65 | 124 |
| August 21 | do | 433 | 662 | 3.06 | 3.00 | 2,029 |
| August 22 | do | 465 | 982 | 3.38 | 3.30 | 3,323 |
| August 23 | do | 430 | 625 | 2.78 | 2.90 | 1,739 |
| September 22 | do | 87 | 27 | .85 | 1.20 | 23 |
| October 2 | do | | 2,918 | 4.42 | 6.25 | 12,890 |
| October 19 | do | 335 | 371 | 1.95 | 1.90 | 723 |
| November 10 | do | | 193 | 1.81 | 1.30 | 350 |

*Mean daily gage height, in feet, of Arkansas River near Dodge, Kans., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.20 | 1.30 | 1.20 | 1.00 | 1.00 | 2.00 | 2.00 | 1.80 | 1.60 | 1.50 | 1.40 | 1.10 |
| 2 | 1.20 | 1.30 | 1.20 | 1.00 | 1.10 | 2.00 | 1.95 | 1.70 | 1.60 | 6.75 | 1.40 | 1.10 |
| 3 | 1.10 | 1.30 | 1.20 | 1.00 | 1.40 | 2.00 | 1.85 | 1.55 | 1.60 | 6.25 | 1.40 | 1.10 |
| 4 | 1.10 | 1.30 | 1.20 | 1.00 | 1.50 | 1.85 | 1.80 | 2.40 | 1.60 | 4.50 | 1.40 | 1.40 |
| 5 | 1.10 | 1.30 | 1.20 | 1.00 | 2.45 | 1.70 | 1.80 | 2.25 | 1.70 | 3.90 | 1.40 | 1.50 |
| 6 | 1.10 | 1.30 | 1.20 | 1.00 | 3.00 | 1.60 | 1.70 | 1.80 | 1.80 | 3.40 | 1.40 | 1.45 |
| 7 | 1.10 | 1.30 | 1.20 | 1.00 | 2.55 | 1.60 | 1.70 | 1.65 | 1.90 | 2.85 | 1.40 | 1.40 |
| 8 | 1.10 | 1.30 | 1.20 | 1.00 | 2.25 | 1.50 | 1.80 | 1.70 | 2.05 | 2.40 | 1.30 | 1.30 |
| 9 | 1.10 | 1.30 | 1.10 | 1.00 | 2.05 | 1.50 | 1.90 | 2.45 | 1.95 | 2.25 | 1.30 | 1.30 |
| 10 | 1.10 | 1.30 | 1.10 | 1.00 | 2.00 | 1.50 | 1.85 | 2.30 | 1.75 | 2.20 | 1.30 | 1.30 |
| 11 | 1.20 | 1.20 | 1.10 | 1.00 | 1.80 | 4.75 | 1.80 | 2.00 | 1.60 | 2.10 | 1.30 | 1.30 |
| 12 | 1.20 | 1.20 | 1.10 | 1.00 | 1.80 | 4.50 | 2.00 | 1.90 | 1.60 | 1.95 | 1.30 | 1.30 |
| 13 | 1.20 | 1.20 | 1.00 | .90 | 1.70 | 4.45 | 2.10 | 1.80 | 1.60 | 1.85 | 1.30 | 1.40 |
| 14 | 1.20 | 1.30 | 1.00 | .90 | 1.70 | 3.55 | 2.00 | 1.80 | 1.50 | 2.00 | 1.25 | 1.40 |
| 15 | 1.20 | 1.30 | 1.00 | .90 | 1.60 | 4.20 | 2.00 | 1.70 | 1.50 | 2.00 | 1.20 | 1.40 |
| 16 | 1.10 | 1.30 | 1.00 | .90 | 1.50 | 3.80 | 2.00 | 1.60 | 1.40 | 1.95 | 1.20 | 1.40 |
| 17 | 1.10 | 1.40 | 1.00 | .90 | 1.50 | 3.50 | 1.85 | 1.50 | 1.40 | 1.85 | 1.10 | 1.40 |
| 18 | 1.10 | 1.40 | 1.00 | .90 | 1.40 | 3.10 | 1.70 | 1.60 | 1.30 | 1.85 | 1.10 | 1.40 |
| 19 | 1.10 | 1.40 | 1.00 | .90 | 1.30 | 2.75 | 1.60 | 1.65 | 1.30 | 1.90 | 1.10 | 1.40 |
| 20 | 1.10 | 1.40 | 1.00 | .90 | 1.30 | 2.60 | 1.60 | 1.55 | 1.20 | 1.90 | 1.10 | 1.40 |
| 21 | 1.10 | 1.40 | 1.00 | .90 | 1.30 | 2.50 | 1.70 | 3.10 | 1.20 | 1.80 | 1.10 | 1.40 |
| 22 | 1.10 | 1.40 | 1.00 | .90 | 1.30 | 2.55 | 1.70 | 3.20 | 1.20 | 1.65 | 1.10 | 1.40 |
| 23 | 1.10 | 1.40 | 1.00 | 1.10 | 1.30 | 4.65 | 1.60 | 2.80 | 1.15 | 1.60 | 1.10 | 1.45 |
| 24 | 1.10 | 1.30 | 1.00 | 1.00 | 3.30 | 3.50 | 1.50 | 2.55 | 1.10 | 1.60 | 1.10 | 1.50 |
| 25 | 1.20 | 1.30 | 1.00 | 1.00 | 2.95 | 2.90 | 1.50 | 2.40 | 1.10 | 1.50 | 1.10 | 1.50 |
| 26 | 1.20 | 1.30 | 1.00 | 1.00 | 2.50 | 2.60 | 1.50 | 2.10 | 1.10 | 1.50 | 1.10 | 1.50 |
| 27 | 1.20 | 1.30 | 1.00 | 1.00 | 2.15 | 2.50 | 1.40 | 2.00 | 1.10 | 1.50 | 1.10 | 1.50 |
| 28 | 1.20 | 1.30 | 1.00 | 1.00 | 1.60 | 2.25 | 1.30 | 1.90 | 1.10 | 1.50 | 1.10 | 1.50 |
| 29 | 1.30 | 1.30 | 1.00 | 1.00 | 1.55 | 2.05 | 1.55 | 1.75 | 1.20 | 1.50 | 1.10 | 1.50 |
| 30 | 1.30 | ..... | 1.00 | 1.00 | 1.80 | 2.00 | 2.00 | 2.05 | 1.50 | 1.50 | 1.10 | 1.50 |
| 31 | 1.30 | ..... | 1.00 | ..... | 1.70 | ..... | 1.90 | 1.75 | ..... | 1.50 | ..... | 1.50 |

*Rating table for Arkansas River near Dodge, Kans., from January 1 to September 17, 1904.*[a]

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 3 | 1.90 | 375 | 2.90 | 2,200 | 3.90 | 5,310 |
| 1.00 | 4 | 2.00 | 490 | 3.00 | 2,470 | 4.00 | 5,680 |
| 1.10 | 8 | 2.10 | 615 | 3.10 | 2,750 | 4.10 | 6,060 |
| 1.20 | 14 | 2.20 | 760 | 3.20 | 3,035 | 4.20 | 6,450 |
| 1.30 | 28 | 2.30 | 925 | 3.30 | 3,330 | 4.30 | 6,850 |
| 1.40 | 40 | 2.40 | 1,100 | 3.40 | 3,635 | 4.40 | 7,260 |
| 1.50 | 70 | 2.50 | 1,285 | 3.50 | 3,950 | 4.50 | 7,680 |
| 1.60 | 115 | 2.60 | 1,490 | 3.60 | 4,275 | 4.60 | 8,110 |
| 1.70 | 180 | 2.70 | 1,710 | 3.70 | 4,610 | 4.70 | 8,550 |
| 1.80 | 270 | 2.80 | 1,945 | 3.80 | 4,955 | | |

[a] Table not used in making the daily estimates on May 5 and 24, August 20 and 21, and August 23 to 26.

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1904. It is not well defined, owing to the shifting character of the channel.

*Estimated monthly discharge of Arkansas River near Dodge, Kans., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January [a] | 28 | 8 | 12.1 | 744 |
| February | 40 | 14 | 29.4 | 1,691 |
| March | 14 | 4 | 7.10 | 437 |
| April | 8 | 3 | 3.80 | 226 |
| May [b] | 3,730 | 4 | 559 | 34,370 |
| June | 8,775 | 70 | 2,456 | 146,100 |
| July | 615 | 28 | 271 | 16,660 |
| August [b] | 3,035 | 70 | 598 | 37,770 |
| September [b] | 550 | 12 | 113 | 6,724 |
| October [b] | 14,800 | 85 | 1,986 | 122,100 |
| November [b] | 395 | 270 | 320 | 19,040 |
| December [ab] | 450 | 270 | 393 | 24,160 |
| The year | 14,800 | 3 | 562 | 409,000 |

[a] River frozen greater portion of January and December. Estimates made same as for open channel.
[b] Discharge for May 5 and 24, August 20, 21, and 23 to 26, September 18 to December 31, estimated indirectly.

## ARKANSAS RIVER AT HUTCHINSON, KANS.

This station was established May 13, 1895, and is located at the wagon bridge at the south end of Main street. The gage consists of a pine timber, 2 by 6 inches by 9 feet, graduated to feet and tenths, and fastened to the downstream pier of fourth set from north end. Bench mark No. 1 is the upper crosspiece of the pier guard. Its elevation is 8.35 feet above the zero of the gage. Bench mark No. 2 is the top of the iron doorsill of the first brick building next to the river. Its elevation is 8.12 feet above gage datum. The channel is straight for some distance above and below the bridge and has a width of 1,020 feet, broken by 11 steel piers. The bed is sandy and very shifting, necessitating frequent discharge measurements and soundings. At low water the stream subdivides into a number of small channels. Measurements of discharge are made from the bridge at high water, and at low water they can be made by wading. The observer is George E. Dixon.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Arkansas River at Hutchinson, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 25 | W. G. Russell | 126 | 44 | 1.48 | 1.30 | 65 |
| May 9 | do | 542 | 653 | 2.06 | 2.71 | 1,344 |
| May 10 | do | 426 | 454 | 2.44 | 2.50 | 1,117 |
| May 27 | do | 244 | 110 | 2.18 | 1.70 | 240 |
| May 27 | do | 426 | 477 | 2.52 | 2.47 | 1,202 |
| May 28 | do | 423 | 374 | 2.49 | 2.36 | 923 |
| June 16 | do | 655 | 1,292 | 3.42 | 3.92 | 4,419 |
| June 17 | do | 744 | 1,596 | 3.22 | 4.32 | 5,151 |
| August 23 | do | 301 | 270 | 2.04 | 2.20 | 550 |
| August 24 | do | 524 | 852 | 2.51 | 3.12 | 2,140 |
| August 25 | do | 504 | 672 | 2.21 | 2.80 | 1,488 |
| October 3 | do | 254 | 184 | 2.04 | 1.95 | 376 |
| October 4 | do | ..... | 1,838 | 4.82 | 4.65 | 8,867 |
| October 5 | do | 892 | 2,073 | 4.54 | 4.95 | 9,419 |

*Mean daily gage height, in feet, of Arkansas River at Hutchinson, Kans., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.20 | 1.50 | 1.45 | 1.30 | 1.50 | 2.25 | 3.30 | 2.25 | 2.20 | 2.02 | 2.20 | 1.80 |
| 2 | 1.15 | 1.50 | 1.45 | 1.30 | 1.50 | 2.25 | 3.38 | 2.15 | 2.20 | 1.95 | 2.15 | 1.80 |
| 3 | 1.25 | 1.50 | 1.45 | 1.35 | 1.50 | 2.37 | 3.22 | 2.20 | 2.12 | 3.22 | 2.15 | 1.75 |
| 4 | 1.25 | 1.55 | 1.45 | 1.35 | 1.57 | 3.25 | 3.38 | 2.25 | 2.05 | 4.80 | 2.10 | 1.70 |
| 5 | 1.30 | 1.55 | 1.45 | 1.32 | 1.57 | 3.40 | 3.92 | 2.25 | 1.85 | 3.92 | 2.10 | 1.65 |
| 6 | 1.30 | 1.55 | 1.45 | 1.30 | 1.60 | 3.05 | 4.85 | 2.25 | 1.95 | 4.32 | 2.10 | 1.60 |
| 7 | 1.35 | 1.55 | 1.45 | 1.35 | 1.50 | 2.65 | 4.68 | 2.18 | 1.90 | 3.90 | 2.05 | 1.60 |
| 8 | 1.35 | 1.55 | 1.45 | 1.35 | 1.75 | 2.40 | 4.20 | 2.05 | 1.90 | 3.65 | 2.05 | 1.55 |
| 9 | 1.35 | 1.55 | 1.40 | 1.35 | 2.68 | 2.17 | 3.80 | 2.32 | 1.60 | 3.50 | 2.05 | 1.50 |
| 10 | 1.30 | 1.55 | 1.40 | 1.40 | 2.45 | 2.10 | 3.40 | 2.30 | 1.85 | 3.25 | 2.00 | 1.50 |
| 11 | 1.35 | 1.55 | 1.40 | 1.40 | 2.40 | 2.00 | 2.97 | 2.25 | 2.08 | 3.00 | 2.10 | 1.45 |
| 12 | 1.35 | 1.55 | 1.40 | 1.35 | 2.40 | 2.00 | 2.75 | 2.20 | 2.10 | 2.92 | 2.10 | 1.40 |
| 13 | 1.35 | 1.55 | 1.40 | 1.35 | 2.15 | 3.20 | 2.70 | 2.12 | 1.98 | 2.90 | 2.05 | 1.40 |
| 14 | 1.40 | 1.55 | 1.40 | 1.35 | 2.10 | 4.02 | 2.70 | 2.45 | 1.90 | 2.80 | 2.05 | 1.40 |
| 15 | 1.40 | 1.55 | 1.40 | 1.35 | 2.10 | 3.82 | 2.60 | 2.25 | 1.80 | 2.70 | 2.05 | 1.40 |
| 16 | 1.45 | 1.55 | 1.35 | 1.35 | 2.05 | 4.15 | 2.60 | 2.30 | 1.60 | 2.65 | 2.05 | 1.45 |
| 17 | 1.45 | 1.50 | 1.35 | 1.35 | 2.00 | 4.35 | 2.55 | 2.30 | 1.70 | 2.65 | 2.05 | 1.50 |
| 18 | 1.45 | 1.50 | 1.35 | 1.35 | 2.00 | 4.30 | 2.48 | 2.30 | 1.65 | 2.60 | 2.05 | 1.55 |
| 19 | 1.45 | 1.50 | 1.30 | 1.35 | 2.00 | 4.00 | 2.45 | 2.25 | 1.60 | 2.60 | 2.00 | 1.55 |
| 20 | 1.40 | 1.50 | 1.40 | 1.35 | 2.00 | 3.65 | 2.45 | 2.28 | 1.50 | 2.50 | 1.95 | 1.55 |
| 21 | 1.40 | 1.50 | 1.25 | 1.35 | 2.00 | 3.48 | 2.40 | 2.25 | 1.50 | 2.50 | 1.95 | 1.55 |
| 22 | 1.45 | 1.50 | 1.25 | 1.35 | 1.85 | 3.35 | 2.35 | 2.22 | 1.50 | 2.45 | 1.90 | 1.55 |
| 23 | 1.45 | 1.45 | 1.25 | 1.45 | 1.85 | 3.10 | 2.30 | 2.20 | 1.50 | 2.40 | 1.90 | 1.62 |
| 24 | 1.45 | 1.45 | 1.25 | 1.50 | 1.80 | 2.85 | 2.30 | 2.58 | 1.50 | 2.40 | 1.85 | 2.00 |
| 25 | 1.45 | 1.45 | 1.30 | 1.55 | 1.70 | 3.60 | 2.65 | 2.75 | 1.60 | 2.35 | 1.80 | 2.00 |
| 26 | 1.50 | 1.45 | 1.40 | 1.55 | 1.62 | 4.00 | 2.60 | 2.58 | 1.60 | 2.30 | 1.80 | 2.05 |
| 27 | 1.50 | 1.45 | 1.40 | 1.50 | 2.67 | 3.85 | 2.48 | 2.50 | 1.50 | 2.25 | 1.85 | 2.00 |
| 28 | 1.50 | 1.45 | 1.40 | 1.50 | 2.35 | 3.45 | 2.48 | 2.45 | 1.40 | 2.25 | 1.85 | 2.00 |
| 29 | 1.55 | 1.45 | 1.32 | 1.45 | 2.37 | 3.30 | 2.45 | 2.35 | 1.40 | 2.20 | 1.85 | 2.00 |
| 30 | 1.50 | ..... | 1.30 | 1.48 | 2.30 | 3.42 | 2.35 | 2.35 | 1.45 | 2.20 | 1.85 | 2.00 |
| 31 | 1.50 | ..... | 1.30 | ..... | 2.25 | ..... | 2.30 | 2.30 | ..... | 2.20 | ..... | 2.00 |

*Rating table for Arkansas River at Hutchinson, Kans., from January 1 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.20 | 50 | 2.20 | 630 | 3.20 | 2,340 | 4.20 | 5,360 |
| 1.30 | 65 | 2.30 | 740 | 3.30 | 2,590 | 4.30 | 5,730 |
| 1.40 | 95 | 2.40 | 860 | 3.40 | 2,850 | 4.40 | 6,110 |
| 1.50 | 135 | 2.50 | 995 | 3.50 | 3,120 | 4.50 | 6,500 |
| 1.60 | 180 | 2.60 | 1,145 | 3.60 | 3,400 | 4.60 | 6,900 |
| 1.70 | 230 | 2.70 | 1,310 | 3.70 | 3,690 | 4.70 | 7,310 |
| 1.80 | 290 | 2.80 | 1,490 | 3.80 | 3,990 | 4.80 | 7,730 |
| 1.90 | 360 | 2.90 | 1,680 | 3.90 | 4,310 | 4.90 | 8,150 |
| 2.00 | 440 | 3.00 | 1,885 | 4.00 | 4,650 | 5.00 | 8,580 |
| 2.10 | 530 | 3.10 | 2,105 | 4.10 | 5,000 | | |

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904, and is well defined.

*Estimated monthly discharge of Arkansas River at Hutchinson, Kans., for 1904.*

[Drainage area, 34,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 157 | 45 | 97.3 | 5,983 | 0.0029 | 0.0033 |
| February | 157 | 115 | 140 | 8,053 | .0041 | .0044 |
| March | 115 | 57 | 89.2 | 5,485 | .0026 | .0030 |
| April | 157 | 65 | 93.7 | 5,576 | .0028 | .0031 |
| May | 1,277 | 135 | 491 | 30,190 | .014 | .016 |
| June | 5,920 | 440 | 2,663 | 158,500 | .078 | .087 |
| July | 7,940 | 740 | 2,073 | 127,500 | .061 | .070 |
| August | 1,400 | 485 | 758 | 46,610 | .022 | .025 |
| September | 630 | 95 | 288 | 17,140 | .0085 | .0095 |
| October | 7,730 | 400 | 1,834 | 112,800 | .054 | .062 |
| November | 630 | 290 | 447 | 26,600 | .013 | .014 |
| December | 485 | 95 | 237 | 14,570 | .0070 | .0081 |
| The year | 7,940 | 45 | 768 | 559,000 | .022 | .305 |

## ARKANSAS RIVER NEAR ARKANSAS CITY, KANS.

This station was established September 23, 1902, by W. G. Russell. It is located on Chestnut Avenue Bridge, one-half mile west of Arkansas City, Kans. The gage is a painted staff graduated to feet and tenths, spiked to the west side of the south pile of the second bent on Chestnut avenue. The bench mark is the top of the cap on the pile which carries the gage. Its elevation is 17.20 feet above the zero of the gage. Bench mark No. 2 is a nail driven into the south pile of the bent of the east abutment. Elevation 11.97 feet. The initial point for soundings is on the left bank. The channel is straight for about 200 feet both above and below the station and has a width of 550 feet, broken by 36 pile piers. Both banks are low and liable to overflow. The bed of the river is sandy and shifting. The current is moderately rapid. The gage is reads daily by A. E. Burton.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Arkansas River near Arkansas City, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 24 | W. G. Russell | 158 | 175 | 1.55 | 3.50 | 272 |
| May 12[a] | Russell and Meyers | 430 | 1,033 | 2.11 | 5.56 | [b] 2,176 |
| May 12 | W. G. Russell | 383 | 856 | 2.23 | 5.56 | 1,909 |
| May 13 | Russell and Meyers | 430 | 990 | 2.06 | 5.45 | [b] 2,034 |
| May 13[a] | W. G. Russell | 382 | 852 | 2.42 | 5.45 | 2,066 |
| June 5 | do | [b] 560 | 6,930 | 3.41 | 13.25 | 23,660 |
| June 6 | do | 554 | 4,547 | 2.85 | 10.70 | 12,940 |
| June 18 | do | 405 | 2,066 | 3.04 | 7.67 | 6,276 |
| June 19 | do | | 1,873 | 2.76 | 7.40 | 5,167 |
| July 10 | E. C. Murphy | [c] 2,287 | 11,290 | 3.57 | 15.20 | 40,310 |
| July 23 | Murphy and Russell | 288 | 1,177 | 2.35 | 5.55 | 2,763 |
| August 26 | W. G. Russell | 198 | 504 | 2.19 | 3.80 | 1,104 |
| October 6 | do | | 1,399 | 4.33 | 7.30 | 6,053 |

[a] At Colorado gage one-half mile below. [b] Some overflow. [c] Flood estimate.

*Mean daily gage height, in feet, of Arkansas River near Arkansas City, Kans., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.80 | 3.50 | 3.80 | 3.80 | 4.20 | 6.20 | 7.00 | 4.80 | 3.70 | 3.30 | 3.50 | 3.20 |
| 2 | 3.70 | 3.50 | 3.90 | 3.60 | 4.10 | 8.10 | 6.90 | 4.70 | 3.60 | 3.30 | 3.40 | 3.10 |
| 3 | 3.70 | 3.60 | 3.90 | 3.80 | 4.30 | 11.20 | 7.50 | 4.60 | 3.40 | 3.30 | 3.40 | 3.00 |
| 4 | 3.80 | 3.60 | 3.70 | 3.90 | 4.20 | 12.90 | 8.70 | 4.40 | 3.40 | 3.30 | 3.40 | 3.00 |
| 5 | 3.70 | 3.60 | 3.60 | 3.60 | 4.30 | 13.30 | 9.50 | 4.20 | 3.50 | 3.30 | 3.30 | 3.00 |
| 6 | 3.70 | 3.50 | 3.70 | 3.70 | 4.50 | 10.80 | 10.50 | 4.30 | 3.60 | 7.30 | 3.40 | 2.90 |
| 7 | 3.60 | 3.70 | 3.70 | 3.70 | 4.60 | 8.90 | 13.30 | 4.50 | 3.50 | 6.90 | 3.40 | 2.90 |
| 8 | 3.60 | 3.70 | 3.60 | 3.80 | 4.70 | 8.10 | 14.20 | 4.60 | 3.40 | 6.50 | 3.40 | 2.80 |
| 9 | 3.40 | 3.90 | 3.60 | 3.70 | 4.80 | 8.20 | 14.95 | 4.50 | 3.40 | 6.20 | 3.30 | 2.90 |
| 10 | 3.50 | 3.90 | 3.70 | 3.70 | 5.60 | 9.10 | 15.20 | 4.50 | 3.30 | 5.80 | 3.30 | 3.00 |
| 11 | 3.40 | 3.80 | 3.80 | 3.80 | 6.20 | 7.60 | 14.50 | 4.40 | 3.40 | 5.30 | 3.40 | 3.10 |
| 12 | 3.30 | 3.70 | 3.90 | 3.90 | 5.60 | 7.70 | 13.80 | 4.20 | 3.40 | 5.10 | 3.30 | 3.10 |
| 13 | 3.10 | 3.70 | 3.80 | 3.90 | 5.45 | 7.60 | 12.50 | 4.00 | 3.40 | 4.90 | 3.60 | 3.00 |
| 14 | 3.20 | 3.80 | 3.80 | 3.80 | 5.10 | 7.50 | 11.80 | 4.10 | 3.30 | 4.60 | 3.50 | 2.90 |
| 15 | 3.30 | 3.90 | 3.70 | 3.80 | 4.90 | 7.60 | 9.20 | 4.20 | 3.30 | 4.40 | 3.60 | 2.90 |
| 16 | 3.30 | 3.80 | 3.70 | 3.70 | 4.80 | 7.80 | 8.10 | 4.40 | 3.30 | 4.10 | 3.50 | 3.00 |
| 17 | 3.60 | 3.80 | 3.70 | 3.60 | 4.90 | 7.40 | 7.20 | 4.30 | 3.30 | 4.00 | 3.40 | 3.00 |
| 18 | 3.70 | 3.70 | 3.60 | 3.60 | 4.80 | 7.80 | 7.00 | 4.20 | 3.40 | 3.80 | 3.40 | 3.10 |
| 19 | 3.80 | 3.70 | 3.60 | 3.70 | 4.70 | 7.40 | 6.40 | 4.20 | 3.40 | 3.90 | 3.30 | 3.10 |
| 20 | 3.70 | 3.60 | 3.70 | 3.60 | 4.60 | 7.30 | 6.30 | 4.10 | 3.30 | 3.80 | 3.30 | 3.20 |
| 21 | 3.70 | 3.70 | 3.80 | 3.50 | 4.50 | 7.00 | 6.10 | 4.10 | 3.30 | 3.80 | 3.30 | 3.30 |
| 22 | 3.80 | 3.80 | 3.80 | 3.50 | 4.90 | 6.60 | 5.80 | 4.00 | 3.20 | 3.90 | 3.40 | 3.30 |
| 23 | 3.80 | 4.10 | 3.90 | 3.40 | 5.00 | 6.40 | 5.50 | 4.00 | 3.30 | 3.90 | 3.40 | 3.20 |
| 24 | 3.70 | 4.20 | 3.50 | 3.60 | 4.90 | 5.90 | 5.70 | 4.10 | 3.30 | 3.80 | 3.30 | 3.20 |
| 25 | 3.70 | 4.30 | 3.60 | 3.90 | 4.70 | 5.80 | 5.40 | 4.10 | 3.30 | 3.80 | 3.40 | 3.30 |
| 26 | 3.60 | 4.20 | 3.70 | 5.60 | 4.60 | 6.00 | 5.20 | 3.80 | 3.20 | 3.70 | 3.30 | 3.30 |
| 27 | 3.40 | 4.10 | 4.40 | 5.30 | 4.00 | 6.60 | 5.20 | 4.20 | 3.20 | 3.60 | 3.30 | 3.40 |
| 28 | 3.40 | 3.80 | 4.70 | 4.80 | 4.20 | 7.20 | 5.10 | 4.10 | 3.30 | 3.60 | 3.30 | 3.40 |
| 29 | 3.40 | 3.70 | 4.90 | 4.60 | 5.30 | 7.00 | 5.00 | 4.00 | 3.40 | 3.50 | 3.30 | 3.30 |
| 30 | 3.40 | ..... | 5.80 | 4.30 | 5.50 | 7.10 | 5.00 | 4.00 | 3.30 | 3.50 | 3.20 | 3.20 |
| 31 | 3.40 | ..... | 3.90 | ..... | 6.10 | ..... | 4.90 | 3.80 | ..... | 3.50 | ..... | 3.10 |

*Rating table for Arkansas River near Arkansas City, Kans., from January 1 to June 1, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.10 | 165 | 3.90 | 453 | 4.70 | 1,096 | 5.50 | 2,080 |
| 3.20 | 185 | 4.00 | 510 | 4.80 | 1,202 | 5.60 | 2,225 |
| 3.30 | 209 | 4.10 | 574 | 4.90 | 1,314 | 5.70 | 2,375 |
| 3.40 | 238 | 4.20 | 644 | 5.00 | 1,430 | 5.80 | 2,530 |
| 3.50 | 272 | 4.30 | 721 | 5.10 | 1,550 | 5.90 | 2,690 |
| 3.60 | 310 | 4.40 | 806 | 5.20 | 1,675 | 6.00 | 2,855 |
| 3.70 | 353 | 4.50 | 898 | 5.30 | 1,805 | 6.10 | 3,025 |
| 3.80 | 401 | 4.60 | 995 | 5.40 | 1,940 | 6.20 | 3,200 |

The above table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1904 and the general form of the curve for 1903. It is fairly well defined.

*Rating table for Arkansas River near Arkansas City, Kans., from June 2 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.80 | 590 | 4.40 | 1,560 | 6.00 | 3,395 | 9.20 | 9,460 |
| 2.90 | 630 | 4.50 | 1,650 | 6.20 | 3,690 | 9.40 | 9,900 |
| 3.00 | 670 | 4.60 | 1,740 | 6.40 | 4,000 | 9.60 | 10,360 |
| 3.10 | 715 | 4.70 | 1,835 | 6.60 | 4,320 | 9.80 | 10,820 |
| 3.20 | 760 | 4.80 | 1,935 | 6.80 | 4,655 | 10.00 | 11,280 |
| 3.30 | 810 | 4.90 | 2,035 | 7.00 | 5,000 | 10.50 | 12,500 |
| 3.40 | 860 | 5.00 | 2,140 | 7.20 | 5,355 | 11.00 | 13,850 |
| 3.50 | 915 | 5.10 | 2,250 | 7.40 | 5,725 | 11.50 | 15,370 |
| 3.60 | 975 | 5.20 | 2,360 | 7.60 | 6,110 | 12.00 | 17,120 |
| 3.70 | 1,035 | 5.30 | 2,475 | 7.80 | 6,510 | 12.50 | 19,280 |
| 3.80 | 1,100 | 5.40 | 2,595 | 8.00 | 6,920 | 13.00 | 22,090 |
| 3.90 | 1,170 | 5.50 | 2,720 | 8.20 | 7,330 | 13.50 | 25,590 |
| 4.00 | 1,240 | 5.60 | 2,845 | 8.40 | 7,750 | 14.00 | 29,900 |
| 4.10 | 1,315 | 5.70 | 2,975 | 8.60 | 8,170 | | |
| 4.20 | 1,395 | 5.80 | 3,110 | 8.80 | 8,595 | | |
| 4.30 | 1,475 | 5.90 | 3,250 | 9.00 | 9,025 | | |

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is fairly well defined. Owing to the shifting character of the stream bed the lack of sufficient measurements may cause considerable error in the application of this table after August 1, 1904.

*Estimated monthly discharge of Arkansas River near Arkansas City, Kans., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 401 | 165 | 301 | 18,510 |
| February | 721 | 272 | 407 | 23,410 |
| March | 2,530 | 272 | 507 | 31,170 |
| April | 2,225 | 238 | 531 | 31,600 |
| May | 3,200 | 510 | 1,321 | 81,230 |
| June | 24,100 | 3,110 | 7,321 | 435,600 |
| July | 40,300 | 2,035 | 11,030 | 678,200 |
| August | 1,935 | 1,100 | 1,435 | 88,230 |
| September | 1,035 | 760 | 847 | 50,400 |
| October | 5,540 | 810 | 1,701 | 104,600 |
| November | 975 | 760 | 850 | 50,580 |
| December | 860 | 590 | 697 | 42,860 |
| The year | 40,300 | 165 | 2,246 | 1,636,000 |

## ARKANSAS RIVER (SALT FORK) NEAR ALVA, OKLA.

This station was established September 10, 1903, by W. G. Russell. It is located at the railway bridge about one-half mile northeast of Alva, Okla. A standard chain gage is attached to the upstream guard rail. The scale is graduated to feet and tenths from 2 feet below to 14 feet above zero. The river bed having sunk may cause minus readings at very low water. The gage is read at irregular periods by Fred. Selfridge. Discharge measurements are made from the upper side of the deck railway bridge to which the gage is attached. This bridge is composed of 146 feet of pile approach at the south end, four 80-foot steel girders resting on stone piers, and 652 feet of pile approach at the north end. The initial point for soundings is at the south end. The channel is curved for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The bed of the stream is composed of clean sand, and is shifting. There are three channels at low and eight at high water. The bench mark is the bottom of the coping stone on the north face of the fourth pier from the south end of the bridge. Its elevation is 8.00 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Arkansas River (Salt Fork) near Alva, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| August 16 | W. G. Russell | 118 | 47 | 1.36 | 0.15 | 64 |
| September 16 | do | 94 | 32 | 1.37 | .10 | 44 |

*Mean daily gage height, in feet, of Arkansas River (Salt Fork) near Alva, Okla., for 1904.*

| Day. | April. | May. | June. | July. | August. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.50 | 1.90 | 1.00 | | | 0.10 | 0.00 | 0.00 |
| 2 | | 1.50 | 1.90 | 4.10 | | | .00 | .00 | .00 |
| 3 | | 1.90 | 2.10 | 3.95 | | | .00 | .00 | .00 |
| 4 | | 1.40 | 2.60 | 2.00 | | | .00 | .00 | .00 |
| 5 | | 1.80 | 1.40 | 1.90 | | | .00 | .00 | .00 |
| 6 | | 1.50 | 1.00 | 1.50 | | | .10 | .00 | .10 |
| 7 | | .80 | .80 | 8.25 | | | .00 | .00 | .20 |
| 8 | | 1.25 | .80 | 3.05 | 1.60 | | .00 | .00 | |
| 9 | | 1.00 | 2.00 | 1.65 | .50 | | .00 | .00 | |
| 10 | | 1.00 | 2.40 | 1.50 | | | .00 | .00 | |
| 11 | | 1.00 | 1.60 | 1.50 | | | .10 | .00 | |
| 12 | | 1.00 | 1.30 | 1.50 | | 1.00 | .10 | .00 | |
| 13 | | | 1.10 | 1.00 | | .60 | .10 | .00 | |
| 14 | | | .80 | .80 | | .20 | .10 | .00 | |
| 15 | | 1.30 | .80 | .50 | | .10 | .00 | .00 | |
| 16 | | 1.70 | .80 | .50 | | .10 | .10 | .00 | |
| 17 | | 1.00 | 1.50 | .50 | 1.10 | .10 | .10 | .00 | |
| 18 | | | .60 | .50 | .80 | .10 | .00 | .00 | |
| 19 | | | 1.40 | .50 | .70 | .10 | .00 | .00 | |
| 20 | | | .90 | .50 | | 1.00 | .00 | .00 | |
| 21 | | | .60 | .50 | | .40 | .00 | .00 | |
| 22 | | 1.60 | .60 | 1.00 | 2.10 | .10 | .10 | .00 | |
| 23 | | 1.40 | .50 | 1.35 | .90 | [a].00 | .00 | .00 | |
| 24 | | 1.20 | .50 | 1.00 | .50 | −.10 | .00 | .00 | |
| 25 | 1.65 | 1.20 | 2.80 | .90 | .50 | −.10 | .00 | .00 | |
| 26 | 1.15 | 1.00 | 2.80 | .90 | .50 | −.10 | .00 | .00 | |
| 27 | 1.00 | 1.00 | 1.90 | .50 | .40 | −.00 | .00 | .00 | |
| 28 | .80 | | 1.00 | .50 | .40 | −.10 | .00 | .00 | |
| 29 | .80 | 1.05 | 1.20 | .20 | | .50 | .00 | .00 | |
| 30 | .80 | 1.00 | 1.20 | | | .20 | .00 | .00 | |
| 31 | | 1.00 | | | | | .00 | | |

[a] The bed was lowered in 1904; hence stream may have flow when gage reads zero or below.

## ARKANSAS RIVER (SALT FORK) NEAR TONKAWA, OKLA.

This station was established September 18, 1903, by W. G. Russell. It is located at the highway bridge one-half mile south of Tonkawa, Okla. A plain, staff gage, graduated to feet and tenths, is spiked vertically to the downstream pile of a bent 198 feet from the north end of the bridge. The gage is read by T. J. Bird. Discharge measurements are made from the downstream side of the bridge to which

the gage is attached. The initial point for soundings is at the north end of the bridge. The channel is straight for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The right bank is low, wooded, and subject to overflow. The left bank is high, wooded, and does not overflow. The bed of the stream is composed of clean sand, and is shifting. There is but one channel at low and high stages, broken only by the pile bents supporting the bridge. The bench mark is the top of a nail driven into a 6-inch cottonwood tree about 40 feet east of the north end of the bridge. Its elevation is 10.50 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Arkansas River (Salt Fork) near Tonkawa, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 29 | W. G. Russell | 338 | 524 | 1.66 | 2.55 | 871 |
| September 20 | do | 175 | 135 | .64 | 1.30 | 87 |

*Mean daily gage height, in feet, of Arkansas River (Salt Fork) near Tonkawa, Okla., for 1903.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.80 | 1.50 | 1.00 | 17 | | 1.20 | 1.10 | 1.10 |
| 2 | | .80 | 3.00 | 1.10 | 18 | 1.10 | 1.10 | 1.10 | 1.10 |
| 3 | | .80 | 3.80 | 1.20 | 19 | 1.10 | 1.00 | 1.20 | 1.10 |
| 4 | | .90 | 3.10 | 1.10 | 20 | 1.10 | .90 | 1.10 | 1.00 |
| 5 | | 1.00 | 2.70 | 1.10 | 21 | .90 | .90 | 1.10 | 1.00 |
| 6 | | 1.10 | 2.10 | 1.10 | 22 | .90 | .90 | 1.10 | 1.00 |
| 7 | | 1.00 | 2.00 | 1.10 | 23 | .80 | .80 | 1.10 | 1.00 |
| 8 | | 1.00 | 1.90 | 1.10 | 24 | .80 | .70 | 1.00 | 1.00 |
| 9 | | .90 | 1.60 | 1.10 | 25 | .80 | .70 | 1.00 | 1.00 |
| 10 | | .90 | 1.50 | 1.20 | 26 | .80 | .70 | 1.00 | 1.00 |
| 11 | | .90 | 1.40 | 1.20 | 27 | .80 | .70 | 1.00 | .90 |
| 12 | | .90 | 1.20 | 1.30 | 28 | .70 | .70 | .90 | 1.00 |
| 13 | | 1.00 | 1.20 | 1.20 | 29 | .70 | .70 | .90 | 1.00 |
| 14 | | 1.00 | 1.10 | 1.20 | 30 | .80 | 8.00 | .90 | 1.00 |
| 15 | | 1.10 | 1.10 | 1.10 | 31 | | 8.00 | | 1.00 |
| 16 | | 1.10 | 1.10 | 1.10 | | | | | |

*Mean daily gage height, in feet, of Arkansas River (Salt Fork) near Tonkawa, Okla., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 1.10 | 1.00 | 1.10 | 1.60 | 3.30 | 2.00 | 2.00 | 1.60 | 1.20 | 1.20 | 1.30 |
| 2 | 1.00 | 1.00 | 1.00 | 1.00 | 6.00 | 4.00 | 8.40 | 1.80 | 1.50 | 1.20 | 1.20 | 1.30 |
| 3 | 1.00 | 1.00 | .90 | .90 | 4.60 | 5.30 | 8.00 | 1.60 | 1.50 | 1.20 | 1.20 | 1.30 |
| 4 | 1.00 | 1.00 | .90 | 1.10 | 4.20 | 6.50 | 6.60 | 1.60 | 1.50 | 1.30 | 1.20 | 1.30 |
| 5 | 1.00 | 1.00 | .80 | 1.00 | 3.50 | 9.50 | 4.60 | 1.60 | 1.40 | 1.30 | 1.20 | 1.30 |
| 6 | 1.00 | 1.00 | .80 | .90 | 3.20 | 8.00 | 8.60 | 1.60 | 1.40 | 1.40 | 1.20 | 1.30 |
| 7 | 1.00 | 1.00 | .80 | .90 | 4.00 | 5.20 | 11.40 | 1.60 | 1.40 | 1.50 | 1.30 | 1.30 |
| 8 | 1.00 | 1.00 | .80 | .90 | 4.20 | 4.20 | 9.00 | 1.60 | 1.40 | 1.50 | 1.20 | 1.40 |
| 9 | 1.00 | 1.10 | .80 | .90 | 6.60 | 3.20 | 6.60 | 2.80 | 1.30 | 1.50 | 1.20 | 1.30 |
| 10 | 1.00 | 1.10 | .80 | .90 | 5.00 | 4.50 | 10.00 | 2.60 | 1.30 | 1.40 | 1.20 | 1.30 |
| 11 | 1.00 | 1.10 | .90 | .90 | 4.00 | 7.00 | 14.60 | 2.00 | 1.30 | 1.40 | 1.20 | 1.30 |
| 12 | 1.00 | 1.10 | .90 | .90 | 3.20 | 5.30 | 12.80 | 1.60 | 1.30 | 1.40 | 1.20 | 1.30 |
| 13 | 1.00 | 1.10 | .90 | .80 | 2.80 | 4.00 | 11.60 | 1.00 | 1.30 | 1.30 | 1.30 | 1.30 |
| 14 | 1.10 | 1.10 | .90 | .80 | 2.40 | 3.00 | 9.00 | 1.00 | 1.30 | 1.30 | 1.30 | 1.30 |
| 15 | 1.10 | 1.10 | .90 | .80 | 2.40 | 2.50 | 7.60 | 1.60 | 1.80 | 1.30 | 1.20 | 1.30 |
| 16 | 1.00 | 1.10 | .90 | .80 | 2.60 | 2.50 | 5.00 | 2.00 | 1.80 | 1.50 | 1.20 | 1.20 |
| 17 | 1.10 | 1.00 | .90 | .80 | 5.00 | 2.30 | 4.60 | 3.00 | 1.70 | 1.50 | 1.20 | 1.20 |
| 18 | 1.10 | 1.00 | .90 | .80 | 3.80 | 2.30 | 3.60 | 5.00 | 1.60 | 1.40 | 1.30 | 1.20 |
| 19 | 1.10 | 1.00 | .90 | .80 | 3.60 | 2.00 | 3.00 | 4.20 | 1.60 | 1.30 | 1.30 | 1.30 |
| 20 | 1.10 | 1.00 | .90 | .70 | 3.00 | 2.20 | 3.00 | 3.90 | 1.60 | 1.30 | 1.30 | 1.30 |
| 21 | 1.10 | 1.00 | .80 | .80 | 2.60 | 2.00 | 3.00 | 3.40 | 1.50 | 1.20 | 1.30 | 1.30 |
| 22 | 1.10 | 1.00 | .80 | .80 | 4.80 | 2.00 | 2.00 | 3.40 | 1.50 | 1.20 | 1.30 | 1.40 |
| 23 | 1.10 | 1.00 | .80 | 2.10 | 5.60 | 2.00 | 5.00 | 3.00 | 1.40 | 1.30 | 1.30 | 1.40 |
| 24 | 1.10 | 1.00 | .80 | 1.90 | 5.00 | 2.10 | 4.60 | 2.70 | 1.50 | 1.20 | 1.30 | 1.40 |
| 25 | 1.10 | 1.00 | .90 | 3.20 | 4.00 | 2.10 | 3.60 | 2.60 | 1.50 | 1.20 | 1.30 | 1.40 |
| 26 | 1.10 | 1.00 | 1.20 | 2.20 | 3.80 | 3.00 | 3.00 | 2.50 | 1.50 | 1.20 | 1.30 | 1.40 |
| 27 | 1.10 | 1.00 | 1.60 | 2.00 | 2.80 | 2.60 | 3.00 | 2.20 | 1.40 | 1.10 | 1.30 | 1.40 |
| 28 | 1.10 | 1.00 | 1.20 | 1.90 | 3.00 | 2.60 | 2.60 | 2.00 | 1.30 | 1.10 | 1.30 | 1.40 |
| 29 | 1.10 | 1.00 | 1.40 | 1.50 | 2.60 | 2.00 | 3.00 | 1.90 | 1.20 | 1.10 | 1.30 | 1.40 |
| 30 | 1.10 | ..... | 1.20 | 1.40 | 2.70 | 2.00 | 1.60 | 1.90 | 1.20 | 1.10 | 1.30 | 1.40 |
| 31 | 1.10 | ..... | 1.10 | ..... | 3.00 | ..... | 1.60 | 1.70 | ..... | 1.20 | ..... | 1.40 |

## CIMARRON RIVER NEAR KENTON, OKLA.

This station was established April 5, 1904, by W. G. Russell. It is located at the highway crossing on the main road, one-half mile north of Kenton, Okla. There are two gages. The first is a plain staff gage 8.5 feet long, graduated to feet and tenths, driven vertically into the bed of the stream and spiked to posts driven into the ground. The second gage is in two sections, the first being the same as and located 70 feet southwest of gage No. 1. The second section is spiked to a cedar post 100 feet east of the first gage. The gage is read at irregular periods by L. A. Wikoff. Discharge measurements are made at low water by wading near the gage. At high stages discharges must be computed from the cross section and slope. The initial point for soundings is on the right bank of the stream. The channel is very narrow and crooked, and the current is sluggish. Both banks are low, wooded, and subject to overflow. The bed of the stream is muddy, but too narrow to shift much. There is but one channel at

low or medium stages, but there may be two at high stages. The bench mark is the top of three nails driven into the west side of a willow tree 18 inches in diameter standing 100 feet southwest of the first gage. Its elevation is 8.15 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Mean daily gage height, in feet, of Cimarron River near Kenton, Okla., for 1904.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 0.40 | 0.50 | 3.93 | 5.53 | 1.65 | 7.20 | 1.00 | 0.80 |
| 2 | ..... | .40 | .50 | 5.00 | 6.90 | 5.15 | 3.90 | .90 | .80 |
| 3 | ..... | 2.86 | .70 | 1.80 | 1.80 | 7.23 | 2.10 | .80 | .80 |
| 4 | ..... | 1.45 | .50 | .70 | 1.30 | 2.00 | 1.70 | .80 | .80 |
| 5 | 0.40 | .60 | .50 | .50 | 1.10 | 1.30 | 1.60 | .90 | .80 |
| 6 | .40 | .50 | .50 | .50 | 4.90 | 1.20 | 1.60 | .90 | .80 |
| 7 | .40 | .40 | .50 | .50 | 1.55 | 1.10 | 1.60 | .90 | .80 |
| 8 | .40 | .40 | .50 | .40 | 1.20 | 1.00 | 1.40 | .90 | .80 |
| 9 | .30 | .40 | .50 | .60 | 1.00 | .90 | 3.50 | .80 | .80 |
| 10 | .40 | .40 | 1.05 | .70 | .90 | .80 | 1.90 | .90 | .80 |
| 11 | .40 | .40 | .50 | 1.00 | .80 | .80 | 1.30 | .90 | 1.00 |
| 12 | .40 | .40 | .50 | .50 | .80 | .80 | 1.10 | .80 | 1.00 |
| 13 | .40 | .40 | .90 | .50 | .80 | 1.85 | 1.10 | .80 | 1.00 |
| 14 | .40 | .40 | .40 | .40 | .80 | .90 | 1.20 | .80 | 1.00 |
| 15 | .40 | .40 | .40 | .40 | .80 | .80 | 1.20 | .80 | 1.00 |
| 16 | .40 | .40 | .30 | .40 | .70 | .80 | 1.20 | .80 | 1.00 |
| 17 | .40 | .50 | .40 | 7.05 | 5.30 | .80 | 1.20 | .90 | .90 |
| 18 | .40 | .40 | .50 | 5.20 | 5.10 | .80 | 1.20 | .90 | .90 |
| 19 | .40 | .40 | .30 | 1.40 | 5.00 | .80 | 1.10 | .90 | .90 |
| 20 | .40 | .50 | .30 | .90 | 1.90 | .80 | 1.10 | .90 | .90 |
| 21 | .40 | .50 | .30 | .60 | 1.30 | 1.25 | 1.10 | .90 | .90 |
| 22 | .40 | 2.87 | 1.70 | 4.43 | 1.20 | .80 | 1.10 | .90 | .90 |
| 23 | .40 | .70 | 4.90 | 4.30 | 1.10 | .80 | 1.00 | .90 | .90 |
| 24 | .40 | .50 | 1.00 | 1.30 | 1.00 | .80 | 1.00 | .80 | .90 |
| 25 | .40 | .50 | .60 | 2.45 | 1.00 | .80 | 1.10 | .80 | .90 |
| 26 | .40 | .50 | .50 | 1.30 | 1.00 | .80 | 1.10 | .80 | .90 |
| 27 | .40 | .50 | .50 | .80 | .90 | 4.45 | 1.00 | .80 | .90 |
| 28 | .30 | .50 | .50 | .70 | .80 | 2.10 | 1.00 | .80 | .90 |
| 29 | .40 | .80 | .40 | .70 | .80 | 5.15 | 1.10 | .80 | .80 |
| 30 | .40 | 1.05 | .40 | 3.80 | .80 | 8.30 | 1.00 | .80 | .80 |
| 31 | ..... | .50 | ..... | 5.00 | .80 | ..... | 1.00 | ..... | ..... |

## CIMARRON RIVER NEAR ARKALON, KANS.

This station was established August 15, 1903, by W. G. Russell. It is located about a half mile north of Arkalon, Kans., at the bridge of the Chicago, Rock Island and Pacific Railway. The gage is a 1 by 4 inch pine timber, 12 feet long, graduated to feet and tenths and spiked to a pile bent on the downstream side of the bridge. This is the fifth bent from the south end of the bridge. The gage is read once each day by Elwin Singer. Discharge measurements are made from the bridge, but can be made at low water by wading. The initial point for soundings is at the south end of the bridge, or the right bank of the river. The channel is straight for about 100 feet above and below the station. The stream is sluggish at low water, but will

probably have a good current when high. Both banks are low and liable to overflow. The railroad embankment is high at each end of the bridge, forcing the water to pass beneath the bridge at all stages. There is but one channel, which is shallow except at high water. The bridge rests upon piles, and drift may at times affect the measurements. The bridge is 245 feet long and 15 feet above the bed of the stream. The bench mark is top of the cap at the east end of the second bent from the south end of the bridge. Elevation, 15.76 feet.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Cimarron River near Arkalon, Kans., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| July 31 | W. G. Russell | 53 | 19 | 1.31 | 0.90 | 25 |
| October 27 | do | | 22 | 1.41 | 1.30 | 31 |

*Mean daily gage height, in feet, of Cimarron River near Arkalon, Kans., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.80 | 0.80 | 0.80 | 0.90 | 0.80 | 0.80 | 0.80 | 0.90 | 0.80 | 2.00 | 1.30 | 1.30 |
| 2 | .80 | .80 | .80 | .90 | .90 | 2.00 | .80 | .80 | .80 | 7.00 | 1.30 | 1.30 |
| 3 | .80 | .80 | .80 | .90 | 1.10 | 1.30 | .80 | .80 | .80 | 5.00 | 1.30 | 1.30 |
| 4 | .80 | .80 | .80 | .80 | 1.00 | 1.20 | .80 | 2.30 | .80 | 4.20 | 1.30 | 1.30 |
| 5 | .80 | .80 | .90 | .80 | .80 | .80 | .80 | 3.00 | .80 | 3.40 | 1.30 | 1.30 |
| 6 | .80 | .80 | .80 | .80 | .80 | .80 | 1.60 | 2.00 | .80 | 2.50 | 1.30 | 1.30 |
| 7 | .80 | .80 | .80 | .80 | .80 | .90 | 1.60 | 1.60 | 4.00 | 2.20 | 1.30 | 1.30 |
| 8 | .80 | .80 | .80 | .80 | .80 | 2.60 | 1.60 | 1.30 | 3.20 | 1.40 | 1.30 | 1.30 |
| 9 | .80 | .80 | .80 | .80 | .80 | 3.80 | 1.10 | 1.00 | 1.60 | 1.50 | 1.30 | 1.30 |
| 10 | .80 | .80 | .80 | .80 | .80 | 1.70 | .90 | 1.40 | .90 | 1.60 | 1.30 | 1.30 |
| 11 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | 1.20 | .90 | 1.60 | 1.30 | 1.30 |
| 12 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | 1.00 | .80 | 1.60 | 1.30 | 1.30 |
| 13 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | 1.60 | 1.30 | 1.30 |
| 14 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | 1.60 | 1.30 | 1.30 |
| 15 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | 1.60 | 1.30 | 1.30 |
| 16 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | .80 | 1.70 | 1.30 | 1.30 |
| 17 | .80 | .80 | .80 | .80 | .80 | 2.60 | .80 | .80 | .80 | 1.80 | 1.30 | 1.30 |
| 18 | .80 | .80 | .80 | .80 | .80 | 1.60 | .80 | .80 | .80 | 1.70 | 1.30 | 1.30 |
| 19 | .80 | .80 | .80 | .80 | .80 | 2.00 | .80 | .80 | .80 | 1.60 | 1.30 | 1.30 |
| 20 | .80 | .80 | .80 | .80 | .80 | 1.20 | .80 | .80 | .80 | 1.60 | 1.30 | 1.30 |
| 21 | .80 | .80 | .80 | .80 | .80 | 1.00 | .80 | 1.50 | .80 | 1.60 | 1.30 | 1.30 |
| 22 | .80 | .80 | .80 | .80 | .80 | 1.10 | .80 | 2.50 | .80 | 1.40 | 1.30 | 1.30 |
| 23 | .80 | .80 | .80 | .90 | .80 | 1.10 | 1.40 | 1.60 | .80 | 1.40 | 1.30 | 1.30 |
| 24 | .80 | .80 | .80 | .90 | .80 | 1.20 | 1.80 | 1.00 | .80 | 1.40 | 1.30 | 1.30 |
| 25 | .80 | .80 | .80 | .80 | .80 | 1.00 | 1.80 | .90 | .80 | 1.40 | 1.30 | 1.30 |
| 26 | .80 | .80 | .80 | .80 | .80 | 1.00 | 1.90 | 80 | 80 | 1.30 | 1.30 | 1.30 |
| 27 | .80 | .80 | .80 | .80 | .80 | 1.40 | 1.70 | .80 | .80 | 1.30 | 1.30 | 1.30 |
| 28 | .80 | .80 | .80 | .80 | .80 | 1.30 | 1.50 | .80 | .80 | 1.30 | 1.30 | 1.30 |
| 29 | .80 | .80 | .80 | .90 | .80 | 1.00 | 1.20 | 80 | 2.00 | 1.30 | 1.30 | 1.30 |
| 30 | .80 | ..... | .80 | .90 | 80 | 80 | .90 | .80 | 1.30 | 1.30 | 1.30 | 1.30 |
| 31 | .80 | ..... | .80 | ..... | .80 | ..... | .90 | 80 | ..... | 1.30 | ..... | 1.30 |

## CIMARRON RIVER NEAR WAYNOKA, OKLA.

This station was established September 11, 1903, by W. G. Russell. It is located at the railway bridge 2½ miles southwest of Waynoka. The gage is a 1 by 4 inch pine board 12 feet long, spiked to the east side of the eighth pile bent from the east end of the bridge. The observer is M. J. Sunden, the section foreman. Discharge measurements are made from the railway bridge, which is supported on piles and has a total span of 2,158 feet. The initial point for soundings is the east end of the bridge. The channel is straight for 1,000 feet above and below the station. Both banks are liable to overflow at very high water. At low water there are several channels. At high water there is one channel, broken by the bridge supports. Bench mark No. 1 is the top of the cap of the bench to which the gage is spiked. Its elevation is 10.93 feet above the zero of the gage. Bench mark No. 2 is the northeast corner of the cap of the bent at the fill at the east end of the bridge on the downstream side. Its elevation is 10.09 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Cimarron River near Waynoka, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| August 17 | W. G. Russell | 426 | 167 | 0.73 | 1.20 | 122 |
| September 17 | do | 195 | 112 | .53 | 1.25 | 59 |

*Mean daily gage height, in feet, of Cimarron River near Waynoka, Okla., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.8 | 0.8 | 1.2 | 0.3 | 2.0 | 0.3 | 1.0 | 1.0 | 1.0 | 2.5 | 1.0 | 1.0 |
| 2 | .8 | .9 | 1.2 | .2 | 1.5 | .3 | 2.0 | 1.2 | 1.0 | 2.0 | 1.0 | 1.0 |
| 3 | .8 | .9 | 1.2 | .2 | 1.3 | 1.7 | 2.5 | 1.5 | 1.0 | 2.0 | 1.0 | 1.0 |
| 4 | .8 | 1.0 | 1.2 | .2 | 1.0 | 1.9 | 2.0 | 1.3 | 1.0 | 2.0 | 1.0 | 1.0 |
| 5 | .9 | 1.0 | 1.2 | .2 | 2.5 | 1.9 | 2.0 | 1.1 | 1.0 | 4.5 | 1.0 | 1.0 |
| 6 | .9 | 1.0 | 1.1 | .2 | 2.0 | 1.7 | 2.5 | 1.0 | 1.0 | 3.0 | 1.0 | 1.3 |
| 7 | .9 | 1.0 | 1.0 | .2 | 2.0 | 1.6 | 4.6 | 1.0 | .9 | 2.5 | 1.0 | 1.2 |
| 8 | .9 | 1.5 | .9 | .2 | 1.5 | 1.5 | 3.5 | 2.0 | .8 | 2.0 | 1.0 | 1.0 |
| 9 | .9 | 1.5 | .8 | .2 | 1.5 | 2.25 | 2.5 | 1.8 | .7 | 2.0 | 1.0 | 1.0 |
| 10 | .9 | 1.5 | .8 | .2 | 1.4 | 2.8 | 2.2 | 1.7 | .6 | 1.8 | 1.0 | 1.0 |
| 11 | .9 | 1.3 | .8 | .2 | 1.3 | 2.7 | 2.0 | 1.5 | 2.0 | 1.6 | 1.0 | 1.0 |
| 12 | 1.2 | 1.2 | .8 | .2 | 1.2 | 2.7 | 1.8 | 1.3 | 1.6 | 1.5 | 1.0 | 1.0 |
| 13 | 1.4 | 1.1 | .8 | .2 | 1.0 | 2.5 | 1.6 | 1.2 | 1.4 | 1.5 | 1.0 | 1.7 |
| 14 | 1.3 | 1.0 | .8 | .2 | 1.0 | 2.5 | 1.5 | 1.1 | 1.2 | 1.5 | 1.0 | 1.7 |
| 15 | 1.2 | 1.0 | .7 | .2 | 1.0 | 2.3 | 1.3 | 1.0 | 1.0 | 1.5 | 1.0 | 1.7 |
| 16 | 1.1 | 1.0 | .7 | .2 | 1.5 | 2.3 | 1.2 | 1.0 | 1.0 | 1.5 | 1.0 | 1.3 |
| 17 | 1.0 | 1.0 | .6 | .2 | 1.5 | 2.0 | 1.0 | 1.0 | 1.0 | 1.5 | 1.0 | 1.3 |
| 18 | 1.1 | 1.0 | .6 | .2 | 1.3 | 1.8 | 1.0 | 2.3 | 1.0 | 1.5 | 1.0 | 1.2 |
| 19 | 1.2 | 1.0 | .5 | .2 | 1.0 | 2.0 | 1.0 | 2.2 | 1.0 | 1.5 | 1.0 | 1.1 |
| 20 | 1.2 | 1.0 | .5 | .2 | .8 | 2.0 | 1.0 | 2.1 | 1.0 | 1.3 | 1.0 | 1.0 |
| 21 | 1.2 | 1.0 | .5 | .3 | .6 | 1.8 | 1.0 | 2,0 | 1.0 | 1.2 | 1.0 | 1.5 |
| 22 | 1.1 | 1.2 | .5 | .3 | .6 | 1.8 | 2.7 | 2.7 | 1.0 | 1.2 | 1.0 | 1.5 |
| 23 | 1.0 | 1.2 | .5 | .3 | .5 | 1.6 | 2.3 | 2.0 | 1.0 | 1.2 | 1.0 | 1.4 |
| 24 | 1.0 | 1.2 | 2.8 | .3 | .5 | 1.5 | 2.0 | 1.5 | 1.0 | 1.1 | 1.0 | 1.4 |
| 25 | .9 | 1.2 | 2.3 | .3 | .4 | 1.5 | 1.8 | 1.3 | 1.0 | 1.0 | 1.0 | 1.4 |
| 26 | .9 | 1.2 | .5 | .3 | .4 | 2.0 | 1.6 | 1.2 | 1.0 | 1.0 | 1.0 | 1.3 |
| 27 | .8 | 1.2 | .5 | .3 | .3 | 1.8 | 1.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.3 |
| 28 | .8 | 1.2 | .5 | .3 | .3 | 1.6 | 1.3 | 1.0 | 1.0 | 1.0 | 1.0 | 1.2 |
| 29 | .8 | 1.2 | .4 | .6 | .3 | 1.5 | 1.2 | 1.0 | 1.0 | 1.0 | 1.0 | 1.2 |
| 30 | .8 | ..... | .4 | 1.0 | .3 | 1.0 | 1.0 | 1.0 | 4.5 | 1.0 | 1.0 | 1.1 |
| 31 | .8 | ..... | .3 | ..... | .3 | ..... | .8 | 1.0 | ..... | 1.0 | ..... | 1.0 |

## VERDIGRIS RIVER NEAR INDEPENDENCE, KANS.

This station was established April 20, 1904, by M. C. Hinderlider, for the purpose of making flood observations. It is located at the highway bridge three-fourths mile northwest of Independence, Kans. A standard chain gage is attached to the upstream guard rail near the south end of the bridge. The gage reads zero when elevation of bottom of weight is 55.893. When the river is high the gage is read by E. Luck. Discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is the south face of the north abutment. The channel is straight for one-fourth mile above and below the station. The current is swift. Both banks are high rock cliffs covered with trees. The left bank overflowed in the flood of 1903. The bed of the stream is composed of gravel and bed rock, and is permanent. There is but one channel, divided at higher stages by one stone pier. Bench mark No. 1 is the top of the capstone on the upstream side of the

main pier in the stream, marked "U. S. B. M. No. 1." Its elevation is 44.107 feet above the datum of the gage. Bench mark No. 2 is the top stone of the north abutment at the end of the bridge on the upstream side, marked "U. S. B. M. No. 2." Its elevation is 42.686 feet above the datum of the gage. Bench mark No. 3 is the top of the stone step in the upstream wing of the north abutment, marked "U. S. B. M. No. 3." Its elevation is 38.000 feet above the datum of the gage. Bench mark No. 4 is the top of the stone in the upstream wing wall of the south abutment, marked "U. S. B. M. No. 4." Its elevation is 45.168 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Mean daily gage height, in feet, of Verdigris River near Independence, Kans., for 1904.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|
| 1 | | | | 25.20 | | |
| 2 | | | 20.75 | 27.60 | 19.60 | |
| 3 | | | 38.48 | | | |
| 4 | | | 43.45 | 35.20 | | |
| 5 | | | 43.85 | | | |
| 6 | | | 44.20 | 37.50 | 7.20 | |
| 7 | | 21.55 | 44.55 | 43.70 | | |
| 8 | | | 41.85 | 48.40 | | |
| 9 | | | 46.10 | 48.80 | | |
| 10 | | | | 44.90 | | |
| 11 | | | | 41.10 | | |
| 12 | | | 37.05 | 34.85 | | |
| 13 | | | 36.25 | 23.00 | | |
| 14 | | | 23.40 | 14.00 | | |
| 15 | | | 18.00 | 10.90 | | |
| 16 | | | 29.65 | | | |
| 17 | | 26.80 | 35.15 | 13.60 | 16.70 | |
| 18 | | | 40.55 | | 18.80 | |
| 19 | | | 42.55 | | 16.40 | |
| 20 | | | 37.30 | | | |
| 21 | | | 25.60 | 10.20 | | |
| 22 | | | 20.40 | | 21.00 | |
| 23 | | | | 8.70 | 15.30 | 9.60 |
| 24 | 7.90 | | | | 11.70 | 15.10 |
| 25 | 32.90 | | | 17.20 | | |
| 26 | 36.30 | | 24.20 | | | |
| 27 | | | 30.45 | | | |
| 28 | | | 32.00 | 12.70 | | |
| 29 | | | 27.20 | | | |
| 30 | | | 21.80 | 8.10 | | |
| 31 | | | | | | |

## VERDIGRIS RIVER NEAR CATOOSA, IND. T.

This station was established September 25, 1903, by W. G. Russell. It is located at the Frisco Railway bridge 2 miles northeast of Catoosa, Ind. T. A standard chain gage is attached to the guard rail of the railway bridge. The scale is graduated to feet and tenths along the guard rail. The gage is read at irregular periods by John L. Calloway. Discharge measurements are made from the single span steel railway bridge and its approaches. The initial point for soundings is at the west end of the bridge, 338 feet from the zero of the gage scale. The channel is straight for 200 feet above and below the bridge. The current is sluggish. Both banks are low, wooded, and subject to overflow, but all water passes beneath the bridge and its approaches. At low water there is one channel, and at high water the channel is broken by the stone piers in the pile supports of the bridge, making five channels. The gaging section is obstructed by broken piles, upon which drift collects. During high water it is impossible to get any but surface velocities, and much of the current out of the main channel has a very slow velocity. The bench mark is the top of the second stone pier from the west and upstream side of the bridge. Its elevation is 50.21 feet above the zero of the gage.

The observations of this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Verdigris River near Catoosa, Ind. T., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 2 | W. G. Russell | 161 | 820 | 3.46 | 7.20 | 2,834 |
| June 10 | do | 852 | 14,600 | 3.23 | 47.20 | 47,230 |
| June 11 | do | 854 | 15,610 | 3.47 | 48.40 | 54,240 |

*Mean daily gage height, in feet, of Verdigris River near Catoosa, Ind. T., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.90 | 3.50 | 3.10 | 4.60 | 12.00 | 12.50 | 37.00 | 6.50 | 4.50 | 5.40 | 3.20 | 3.00 |
| 2 | 4.00 | 3.30 | 3.10 | 4.50 | 7.20 | 22.30 | 34.10 | 6.40 | 4.40 | 5.40 | 3.30 | 3.00 |
| 3 | 4.00 | 3.40 | 3.00 | 4.50 | 6.70 | 28.00 | 42.30 | 9.00 | 4.20 | 5.40 | 3.20 | 3.00 |
| 4 | 3.50 | 3.40 | 3.00 | 4.40 | 5.90 | 35.10 | 44.00 | 14.00 | 4.20 | 4.00 | 3.30 | 3.00 |
| 5 | 3.50 | 3.50 | 3.00 | 3.90 | 6.10 | 45.85 | 44.60 | 10.30 | 4.30 | 3.90 | 3.20 | 3.00 |
| 6 | 3.50 | 3.40 | 3.00 | 3.80 | 6.30 | 46.20 | 45.00 | 8.30 | 4.20 | 3.80 | 3.20 | 3.00 |
| 7 | 3.50 | 3.30 | 3.00 | 3.50 | 11.30 | 46.00 | 47.40 | 8.00 | 4.10 | 3.70 | 3.20 | 3.00 |
| 8 | 3.50 | 3.30 | 3.00 | 4.10 | 16.70 | 46.30 | 48.30 | 7.80 | 4.10 | 3.60 | 3.20 | 3.00 |
| 9 | 3.50 | 3.30 | 3.00 | 3.70 | 20.00 | 46.60 | 48.30 | 7.40 | 4.00 | 3.60 | 3.20 | 3.00 |
| 10 | 3.40 | 3.30 | 3.00 | 4.00 | 15.40 | 47.60 | 48.30 | 7.20 | 3.90 | 3.50 | 3.20 | 3.00 |
| 11 | 3.30 | 3.30 | 3.00 | 4.90 | 17.00 | 48.40 | 48.40 | 7.00 | 3.80 | 3.40 | 3.20 | 3.00 |
| 12 | 3.30 | 3.30 | 3.00 | 4.90 | 11.20 | 48.80 | 48.80 | 6.90 | 3.80 | 3.30 | 3.20 | 3.00 |
| 13 | 3.30 | 3.30 | 3.00 | 5.00 | 10.20 | 47.40 | 49.40 | 5.60 | 3.70 | 3.30 | 3.20 | 3.00 |
| 14 | 3.30 | 3.30 | 3.00 | 4.90 | 7.70 | 45.30 | 49.40 | 5.60 | 3.70 | 3.20 | 3.10 | 3.00 |
| 15 | 3.30 | 3.30 | 3.00 | 4.80 | 7.00 | 43.90 | 48.80 | 5.50 | 3.60 | 3.20 | 3.10 | 3.00 |
| 16 | 3.30 | 3.30 | 3.00 | 4.70 | 6.90 | 43.00 | 45.50 | 5.40 | 4.20 | 3.20 | 3.10 | 3.00 |
| 17 | 3.30 | 3.30 | 3.00 | 4.60 | 6.40 | 37.00 | 33.10 | 5.30 | 4.00 | 3.50 | 3.10 | 3.00 |
| 18 | 3.30 | 3.30 | 3.00 | 4.50 | 18.00 | 35.70 | 28.30 | 5.10 | 3.70 | 3.50 | 3.10 | 3.00 |
| 19 | 3.30 | 3.30 | 3.00 | 3.90 | 20.40 | 35.00 | 20.20 | 5.10 | 3.70 | 3.40 | 3.10 | 3.00 |
| 20 | 3.30 | 3.30 | 3.00 | 3.80 | 22.80 | 34.90 | 12.40 | 17.00 | 3.60 | 3.40 | 3.10 | 3.00 |
| 21 | 5.40 | 3.30 | 2.90 | 3.70 | 13.90 | 33.90 | 10.40 | 13.00 | 3.60 | 3.40 | 3.00 | 3.00 |
| 22 | 6.10 | 3.30 | 2.90 | 3.60 | 12.20 | 36.70 | 9.50 | 9.10 | 3.70 | 3.30 | 3.00 | 3.00 |
| 23 | 5.40 | 3.30 | 2.90 | 3.60 | 11.00 | 37.20 | 8.50 | 16.10 | 3.70 | 3.30 | 3.00 | 3.00 |
| 24 | 5.60 | 3.30 | 2.90 | 4.60 | 9.30 | 33.20 | 8.50 | 29.10 | 8.30 | 3.30 | 3.00 | 3.50 |
| 25 | 5.40 | 3.30 | 3.60 | 18.10 | 8.90 | 31.30 | 8.40 | 24.90 | 12.60 | 3.20 | 3.00 | 3.50 |
| 26 | 5.40 | 3.30 | 4.40 | 26.90 | 7.00 | 22.25 | 8.00 | 16.10 | 12.10 | 3.20 | 3.00 | 3.60 |
| 27 | 4.80 | 3.20 | 4.20 | 30.30 | 6.80 | 26.40 | 7.60 | 8.00 | 11.00 | 3.20 | 3.00 | 3.60 |
| 28 | 4.50 | 3.20 | 4.00 | 31.40 | 6.50 | 41.30 | 7.00 | 6.10 | 5.50 | 3.20 | 3.00 | 3.60 |
| 29 | 4.10 | 3.10 | 7.10 | 32.70 | 8.50 | 42.60 | 6.40 | 5.20 | 5.40 | 3.20 | 3.00 | 3.60 |
| 30 | 3.80 | ..... | 5.80 | 23.85 | 7.00 | 39.10 | 6.10 | 4.70 | 5.40 | 3.20 | 3.00 | 3.60 |
| 31 | 3.60 | ..... | 4.70 | ..... | 8.00 | ..... | 6.20 | 4.60 | ..... | 3.20 | ..... | 3.60 |

## FALL RIVER AT FALLRIVER, KANS.

This station was established as a flood station, April 22, 1904, by M. C. Hinderlider. It is located at the highway bridge, one-eighth mile north of Fallriver, Kans. The original gage was a standard wire and weight gage bolted to the downstream railing near the left end of the bridge. The scale, graduated to feet and tenths from zero to 40 feet, extends horizontally along the rail. The elevation of the bottom of the weight when the gage reads zero is 58.232. On August 28, 1904, the wire cable was replaced by the regulation chain, at the same datum. During 1904 the gage was read once daily, or hourly during dangerous rises in the stream, by Jesse McDaniel. Discharge measurements are made from the three-span bridge to which the gage is attached. The initial point for soundings is the surface of the ground at the north side of the right abutment. The channel is straight for about 300 feet above and 500 feet below the station, and the current is sluggish at low stages and swift at high stages. The

right bank is of loam, sloping gradually out for about 100 feet, then sandstone cliffs from 10 to 15 feet high. The left bank slopes at an angle of about 45° to the height of the bridge floor. Both banks are timbered, and do not overflow except at extreme stages. The low ground on the left bank extending outward from the northwest end of the bridge is overflowed at very high stages of the river. The bed of the stream is composed of loam and mud, and is probably unstable. Bench mark No. 1 is the top of the south masonry abutment on the downstream side; its elevation is 41.768 feet above gage datum. Bench mark No. 2 is on the sandstone ledge at the foot of the northeast corner of the south abutment; its elevation is 33.777 feet above gage datum. Bench mark No. 3 is the top of the first pier from the right bank on the downstream side; its elevation is 41.028 feet above gage datum. Bench mark No. 4 is the top of the second pier from the right bank, downstream end; its elevation is 40.076 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Mean daily gage height, in feet, of Fall River at Fallriver, Kans., for 1904.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 5.35 | 13.15 | 11.85 | 3.90 | 2.40 | 2.40 | 2.20 |
| 2 | ..... | 5.35 | 10.00 | 22.25 | 4.10 | 2.40 | 2.40 | 2.20 |
| 3 | ..... | 5.65 | 25.75 | 10.25 | 3.65 | 2.30 | 2.40 | 2.20 |
| 4 | ..... | 7.25 | 29.45 | 12.20 | 3.45 | 2.20 | 2.40 | 2.20 |
| 5 | ..... | 11.15 | 11.40 | 15.25 | 3.25 | 2.20 | 2.40 | 2.20 |
| 6 | ..... | 16.10 | 7.95 | 33.05 | 3.05 | 2.20 | 2.40 | 2.20 |
| 7 | ..... | 9.05 | 6.40 | 30.75 | 3.00 | 2.20 | 2.40 | 2.20 |
| 8 | ..... | 12.00 | 5.50 | 33.05 | 3.00 | 2.20 | 2.40 | 2.10 |
| 9 | ..... | 9.45 | 11.15 | 10.20 | 3.00 | 2.15 | 2.40 | 2.10 |
| 10 | ..... | 6.55 | 29.15 | 16.27 | 3.00 | 2.10 | 2.40 | 2.10 |
| 11 | ..... | 5.25 | 25.85 | 11.50 | 3.00 | 2.10 | 2.40 | 2.10 |
| 12 | ..... | 4.95 | 9.25 | 7.25 | 2.90 | 2.10 | 2.45 | 2.10 |
| 13 | ..... | 5.50 | 7.70 | 6.35 | 2.80 | 2.10 | 2.40 | 2.10 |
| 14 | ..... | 5.20 | 10.85 | 6.00 | 2.70 | 2.10 | 2.35 | 2.00 |
| 15 | ..... | 5.95 | 8.40 | 10.20 | 2.70 | 2.10 | 2.35 | 2.00 |
| 16 | ..... | 17.00 | 36.70 | 7.25 | 2.70 | 2.10 | 2.35 | 2.00 |
| 17 | ..... | 9.05 | 22.25 | 4.90 | 2.70 | 2.10 | 2.30 | 2.00 |
| 18 | ..... | 7.30 | 8.95 | 4.45 | 3.65 | 2.05 | 2.30 | 2.00 |
| 19 | ..... | 6.65 | 12.10 | 4.20 | 3.40 | 2.00 | 2.30 | 2.00 |
| 20 | ..... | 6.15 | 7.55 | 4.00 | 3.25 | 2.00 | 2.30 | 2.00 |
| 21 | ..... | 6.65 | 7.80 | 3.75 | 3.70 | 2.00 | 2.20 | 2.00 |
| 22 | 3.50 | 6.10 | 5.70 | 3.55 | 3.55 | 2.40 | 2.20 | 2.00 |
| 23 | 4.00 | 5.55 | 7.10 | 3.50 | 3.50 | 2.40 | 2.20 | 2.00 |
| 24 | 27.90 | 4.90 | 4.90 | 3.50 | 3.45 | 2.35 | 2.20 | 2.00 |
| 25 | 13.50 | 4.50 | 16.27 | 3.50 | 3.30 | 2.25 | 2.20 | 2.00 |
| 26 | 8.30 | 10.15 | 9.60 | 3.50 | 2.95 | 2.30 | 2.20 | 2.00 |
| 27 | 6.30 | 6.75 | 13.75 | 3.50 | 2.75 | 2.40 | 2.20 | 2.00 |
| 28 | 6.05 | 5.30 | 7.60 | 3.90 | 2.60 | 2.40 | 2.20 | 2.00 |
| 29 | 5.85 | 5.80 | 12.50 | 4.10 | 2.60 | 2.40 | 2.20 | 2.00 |
| 30 | 5.70 | 7.00 | 14.25 | 3.65 | 2.50 | 2.40 | 2.20 | 2.00 |
| 31 | ..... | 6.70 | ..... | 3.45 | 2.45 | ..... | 2.20 | ..... |

## NEOSHO RIVER NEAR NEOSHO RAPIDS, KANS.

This station was established as a flood station May 11, 1904, by W. G. Russell. It is located at the Atchison, Topeka and Santa Fe Railway bridge, about 2 miles below the junction of Neosho and Cottonwood rivers and about 1 mile west of Neosho Rapids.

The gage consists of a standard wire and weight gage located on the downstream side of the railroad bridge near the left or east end. The gage is marked on the guard rail of the bridge from zero to 40 feet, the foot marks being shown by brass headed nails and the tenth marks by ordinary tacks.

During the season of 1904 the gage was read twice daily by L. H. Hendrickson, section foreman for the Atchison, Topeka and Santa Fe Railway at Neosho Rapids. Discharge measurements are made from the downstream side of the railroad bridge to which the gage is attached. The initial point for soundings is the west face of the east masonry abutment on the downstream side of the bridge. There is but one channel, which is straight for several hundred feet above and below the bridge, the current being sluggish at low and fairly rapid at high stages. The bed of the stream is composed of mud and silt and irregular. Owing to the irregular shape of the bed of the channel an island appears in the channel beneath the bridge at low water. Both banks are of loam, and rise above low water for a height of from 10 to 15 feet, but are overflowed during high stages of the river, cultivated lands on either side being flooded for long distances out.

Bench mark No. 1 is a cross on the top of the left abutment on downstream side; its elevation is 38.75 feet above the datum of the gage. Bench mark No. 2 is a mark on the top of the southwest corner of the left abutment; its elevation is 35.71 feet above the datum of the gage. Bench mark No. 3 is a mark on the top of the southwest corner of the coping of the left abutment; its elevation is 33.71 feet above the datum of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Mean daily gage height, in feet, of Neosho River near Neosho Rapids, Kans., for 1904.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|
| 1 | ..... | 31.40 | 21.20 | 12.75 | 11.60 | 9.85 | 9.50 |
| 2 | ..... | 28.55 | 16.85 | 12.60 | 11.80 | 9.95 | 9.50 |
| 3 | ..... | 32.50 | 18.55 | 12.50 | 11.70 | 10.05 | 9.50 |
| 4 | ..... | 34.75 | 19.75 | 12.65 | 11.55 | 9.90 | 9.50 |
| 5 | ..... | 33.20 | 25.10 | 12.40 | 11.40 | 9.85 | 9.50 |
| 6 | ..... | 30.25 | 32.20 | 12.15 | 11.40 | 9.80 | ..... |
| 7 | ..... | 27.55 | 35.25 | 12.30 | 11.40 | 9.80 | ..... |
| 8 | ..... | 25.05 | 35.15 | 12.30 | 11.40 | 9.80 | ..... |
| 9 | ..... | 18.35 | 34.15 | 12.00 | 11.40 | 9.80 | ..... |
| 10 | ..... | 19.40 | 33.65 | 12.00 | 11.40 | 9.80 | ..... |
| 11 | ..... | 29.35 | 33.10 | 12.15 | 9.90 | 9.80 | ..... |
| 12 | ..... | 29.05 | 32.40 | 12.05 | 9.90 | 9.80 | ..... |
| 13 | ..... | 24.25 | 29.70 | 12.00 | 9.80 | 9.80 | ..... |
| 14 | ..... | 17.25 | 25.05 | 11.95 | 9.80 | 9.80 | ..... |
| 15 | 13.60 | 15.25 | 16.80 | 11.90 | 10.05 | 9.70 | ..... |
| 16 | 20.80 | 18.05 | 16.95 | 11.90 | 9.90 | 9.65 | ..... |
| 17 | 26.70 | 21.00 | 16.25 | 11.90 | 9.90 | 9.60 | ..... |
| 18 | 26.05 | 23.35 | 14.80 | 11.90 | 9.80 | 9.60 | ..... |
| 19 | 20.45 | 25.85 | 12.80 | 11.90 | 9.80 | 9.60 | ..... |
| 20 | 14.35 | 25.35 | 17.50 | 11.90 | 9.80 | 9.60 | ..... |
| 21 | 13.70 | 18.95 | 14.20 | 11.90 | 9.80 | 9.60 | ..... |
| 22 | 13.55 | 15.80 | 17.90 | 12.15 | 9.80 | 9.60 | ..... |
| 23 | 13.40 | 14.75 | 18.50 | 13.75 | 9.80 | 9.50 | ..... |
| 24 | 13.30 | 14.00 | 15.20 | 13.80 | 9.90 | 9.50 | ..... |
| 25 | 12.90 | 23.85 | 14.90 | 12.50 | 9.90 | 9.50 | ..... |
| 26 | 14.45 | 31.65 | 13.50 | 11.90 | 9.90 | 9.50 | ..... |
| 27 | 21.05 | 33.05 | 13.50 | 11.90 | 9.90 | 9.50 | ..... |
| 28 | 19.20 | 30.40 | 13.45 | 11.80 | 9.80 | 9.50 | ..... |
| 29 | 25.00 | 26.85 | 13.25 | 11.75 | 9.80 | 9.50 | ..... |
| 30 | 33.05 | 21.90 | 13.00 | 11.60 | 9.80 | 9.50 | ..... |
| 31 | 32.80 | ..... | 12.90 | 11.60 | ..... | 9.50 | ..... |

## NEOSHO RIVER NEAR HUMBOLDT, KANS.

This station was established as a flood water station April 19, 1904, by M. C. Hinderlider. It is located at the highway bridge about one-half mile west of Humboldt, Kans. A standard wire and weight gage was fastened to the downstream guard rail of the bridge near the left end. The scale is graduated to feet and tenths. On August 30, 1904, the wire cable of the gage was replaced by a regulation chain, at the same datum. The gage was read once daily, and oftener during sudden changes in the stage of the river during the flood periods of 1904, by W. P. McGrew. Discharge measurements are made from the single-span bridge to which the gage is attached. The initial point for soundings is at the foot of the perpendicular cliff on the left bank of the river, at the east end of the bridge. The channel is permanent, having a sandstone bottom. The current is sluggish at low and fairly swift at high stages of flow. The right bank is low, timbered, and is subject to overflow. The left bank is high, and is not subject to over-

flow. The bed of the stream is composed of solid rock, and permanent. There is a masonry dam about 100 yards below the bridge, used for developing power for the gristmill near by. This dam is 300 feet long, there being a difference between the surface of the river above and below the dam of 7.14 feet. Bench mark No. 1 is a United States Geological Survey standard bench mark tablet, set into the stone coping in the south side of the Humboldt National Bank building, on the northwest corner of Eighth and Bridge streets, midway between the two south windows, two feet above the top of the sidewalk. Its elevation is 69.629 feet above the datum of the gage. Bench mark No. 2 is a cross on the cliff, 10 feet south and 15 feet west of the left end of the bridge. It is marked "U. S. B. M." Its elevation is 20.942 feet above gage datum. Bench mark No. 3 is a cross on the top of the third stone from the bottom in the south face of the south wing of the right abutment. It is marked "B. M." Its elevation is 12.225 feet above the datum of the gage. This station has been abandoned.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Mean daily gage height, in feet, of Neosho River near Humboldt, Kans., for 1904.*

| Day. | Apr. | May. | June. | July. | Day. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 21.00 | 22.80 | 17 | | 18.75 | 18.00 | 12.00 |
| 2 | | | 22.95 | 21.80 | 18 | | 18.00 | 13.20 | 7.00 |
| 3 | | | 28.15 | 13.90 | 19 | | 16.80 | 12.80 | |
| 4 | | | 28.90 | 11.65 | 20 | | 15.65 | 15.10 | |
| 5 | | | 27.60 | 13.35 | 21 | | 7.50 | 15.90 | |
| 6 | | 11.00 | 27.30 | 24.20 | 22 | | | 14.00 | |
| 7 | | 13.00 | 28.30 | 26.75 | 23 | 3.00 | | 9.20 | |
| 8 | | 11.90 | 27.40 | 28.50 | 24 | [a]25.90 | | 6.00 | |
| 9 | | | 25.95 | 29.25 | 25 | 25.00 | 4.00 | 14.90 | |
| 10 | | | 24.50 | 30.50 | 26 | | 15.20 | 23.05 | |
| 11 | | | 18.35 | 29.75 | 27 | | 9.50 | 25.95 | |
| 12 | | | 13.25 | 28.70 | 28 | | 11.45 | 24.65 | |
| 13 | | | 15.70 | 27.25 | 29 | | 10.95 | 23.40 | |
| 14 | | | 17.10 | 26.10 | 30 | | 16.85 | 23.10 | |
| 15 | | | 13.15 | 25.05 | 31 | | 19.45 | | |
| 16 | | | 15.75 | 22.95 | | | | | |

[a] Extreme height 29.5.

## GRAND RIVER NEAR FORT GIBSON, IND. T.

This station was established September 22, 1903, by W. G. Russell. It is located at the Missouri Pacific Railway bridge three-fourths of a mile northwest of Fort Gibson, Ind. T. There are two gages. The first is a vertical 2 by 6 inch plank 18 feet long, graduated to feet and tenths from 9 to 27 feet, bolted to the east face of the first stone pier from the left bank. The 9-foot mark is the top of the steel caisson, and below this point gage heights are taken by means of a standard

chain gage let down from a nail in the guard rail, and kept in the pump house when not in use, the scale reading to feet and tenths from zero to 35 feet, being marked along the guard rail. This gage is used only in very low or very high water. Gage heights are taken once each day by W. L. Blackwell. Discharge measurements are made from the downstream side of the three-span steel bridge to which the gages are attached. The bridge has a total length of 625 feet, and has a pile approach of 157 feet at the west end. The bridge is slightly oblique to the course of the current. The initial point for soundings is the edge of the abutment on the left bank of the river. The channel is straight for about 500 feet above and below the station. The current is sluggish except at high water, when it is swift near the right bank. The right bank is high, wooded, and overflows only at very high stages. The left bank is high, rocky, clean, and does not overflow. The bed of the stream is a smooth rock from the left bank to the middle, when it changes to sand and changes with every flood. There are four channels at low and five channels at high water. Drift at very high water makes it possible to get only top velocities. Bench mark No. 1 is a cross, marked "B. M.," on a hard limestone rock in the face of the wall 4 feet above the upstream side of the bridge on the left bank of the river. Its elevation is 24.90 feet above the datum of the gage. Bench mark No. 2 is a United States Geological Survey standard bench mark on the top of the east pier of bridge. It is 516 feet above sea level, and is marked "516." Its elevation is 40.94 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Grand River near Fort Gibson, Ind. T., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 3 | W. G. Russell | 479 | 5,630 | 5.50 | 15.65 | 30,960 |
| June 8 | do | | 11,600 | 6.93 | 27.00 | 80,400 |
| June 12 | do | | 10,140 | 6.15 | 24.45 | 62,410 |
| August 31 | do | 491 | 4,074 | 1.37 | 11.00 | 5,571 |

*Mean daily gage height, in feet, of Grand River near Fort Gibson, Ind. T., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9.60 | 11.00 | 9.10 | 11.50 | 17.80 | 14.00 | 18.80 | 14.60 | 11.00 | 10.00 | 9.20 | 9.00 |
| 2 | 9.50 | 11.00 | 9.10 | 12.00 | 17.60 | 18.60 | 18.20 | 16.20 | 11.00 | 10.80 | 9.20 | 9.00 |
| 3 | 9.40 | 11.00 | 9.10 | 12.00 | 15.80 | 20.00 | 20.00 | 17.80 | 11.00 | 10.60 | 9.30 | 9.00 |
| 4 | 9.40 | 10.60 | 9.10 | 12.00 | 13.60 | 26.50 | 21.00 | 19.50 | 11.00 | 10.40 | 9.30 | 9.00 |
| 5 | 9.40 | 10.50 | 9.10 | 12.00 | 13.00 | 33.00 | 22.60 | 19.80 | 11.00 | 10.20 | 9.30 | 9.00 |
| 6 | 9.40 | 10.00 | 9.10 | 12.00 | 12.00 | 32.60 | 23.00 | 17.00 | 10.90 | 10.00 | 9.40 | 9.00 |
| 7 | 9.40 | 10.00 | 9.10 | 12.00 | 11.20 | 29.00 | 26.00 | 16.50 | 10.90 | 9.80 | 9.40 | 9.00 |
| 8 | 9.40 | 10.00 | 9.10 | 11.80 | 11.40 | 27.00 | 27.00 | 16.00 | 10.80 | 9.60 | 9.40 | 9.00 |
| 9 | 9.40 | 10.00 | 9.10 | 11.60 | 11.80 | 27.00 | 28.00 | 15.20 | 10.80 | 9.40 | 9.40 | 9.00 |
| 10 | 9.40 | 10.00 | 9.10 | 11.60 | 12.00 | 25.50 | 29.00 | 14.00 | 10.80 | 9.20 | 9.40 | 9.00 |
| 11 | 9.40 | 10.00 | 9.10 | 11.60 | 12.80 | 25.50 | 32.40 | 13.80 | 10.90 | 9.20 | 9.40 | 8.90 |
| 12 | 9.40 | 9.60 | 9.10 | 11.50 | 13.00 | 24.00 | 32.20 | 13.60 | 11.00 | 9.00 | 9.50 | 8.90 |
| 13 | 9.40 | 9.40 | 9.00 | 11.50 | 12.00 | 24.00 | 32.00 | 13.00 | 11.00 | 8.80 | 9.40 | 8.90 |
| 14 | 9.40 | 9.30 | 9.00 | 11.20 | 11.10 | 23.20 | 31.60 | 13.80 | 10.90 | 8.80 | 9.20 | 8.90 |
| 15 | 9.30 | 9.30 | 9.00 | 11.00 | 11.40 | 20.00 | 30.80 | 13.60 | 10.00 | 8.60 | 9.20 | 8.90 |
| 16 | 9.30 | 9.30 | 9.00 | 11.00 | 11.80 | 19.50 | 30.00 | 13.40 | 10.00 | 8.60 | 9.20 | 8.90 |
| 17 | 10.00 | 9.30 | 9.00 | 11.00 | 12.00 | 17.00 | 25.00 | 13.00 | 10.00 | 8.60 | 9.20 | 8.90 |
| 18 | 10.00 | 9.30 | 9.00 | 11.00 | 12.80 | 16.50 | 24.60 | 12.80 | 10.80 | 8.60 | 9.10 | 9.00 |
| 19 | 10.00 | 9.30 | 9.00 | 11.00 | 13.00 | 17.00 | 23.00 | 11.60 | 10.80 | 8.60 | 9.10 | 9.00 |
| 20 | 10.00 | 9.30 | 9.00 | 11.00 | 14.00 | 17.50 | 21.00 | 10.50 | 11.00 | 8.60 | 9.10 | 9.00 |
| 21 | 10.20 | 9.30 | 9.10 | 11.00 | 14.00 | 18.20 | 19.20 | 10.80 | 11.00 | 8.80 | 9.10 | 9.00 |
| 22 | 13.00 | 9.20 | 9.10 | 10.80 | 13.80 | 18.00 | 19.00 | 11.00 | 11.00 | 8.80 | 9.10 | 9.00 |
| 23 | 15.50 | 9.20 | 9.10 | 10.50 | 13.40 | 17.10 | 18.20 | 11.50 | 11.00 | 8.80 | 9.10 | 9.00 |
| 24 | 15.00 | 9.20 | 9.20 | 10.50 | 12.20 | 16.40 | 16.00 | 12.00 | 11.80 | 9.20 | 9.00 | 9.00 |
| 25 | 14.80 | 9.10 | 9.20 | 10.80 | 12.00 | 15.00 | 15.80 | 12.80 | 11.80 | 9.20 | 9.00 | 9.00 |
| 26 | 14.40 | 9.10 | 9.20 | 10.90 | 11.80 | 15.40 | 15.20 | 13.00 | 11.60 | 9.20 | 9.00 | 9.00 |
| 27 | 14.00 | 9.10 | 9.30 | 11.80 | 11.60 | 16.00 | 14.80 | 13.50 | 11.40 | 9.20 | 9.00 | 9.00 |
| 28 | 13.00 | 9.10 | 9.70 | 13.50 | 11.20 | 18.80 | 14.40 | 13.00 | 11.20 | 9.20 | 9.00 | 9.00 |
| 29 | 12.00 | 9.10 | 9.80 | 17.80 | 11.80 | 19.00 | 13.80 | 12.00 | 11.00 | 9.20 | 9.00 | 9.00 |
| 30 | 11.00 | ..... | 10.00 | 18.00 | 12.00 | 19.80 | 14.00 | 11.00 | 10.80 | 9.20 | 9.00 | 9.00 |
| 31 | 11.00 | ..... | 10.40 | ..... | 13.00 | ..... | 14.40 | 11.00 | ..... | 9.20 | ..... | 9.00 |

## SOUTH CANADIAN RIVER NEAR LOGAN, N. MEX.

This station was established June 29, 1904, by W. G. Russell. It is located at the bridge of the Chicago, Rock Island and Pacific Railroad 1 mile west of the depot at Logan, N. Mex. A plain staff gage, graduated to feet and tenths from zero to 4 feet, is bolted to the cribwork of a submerged dam about 25 feet below the bridge. The remainder of the gage up to 14 feet is painted upon the concrete pier of the bridge just above. The gage is read once each day by John W. Furlow. Discharge measurements can be made only at low water by wading. For high water stages it will be necessary to compute the discharge from the slope and cross section or by float measurements. As the bridge piers divide the river into several sections, it is quite easy to obtain surface velocities of each. It is impossible to make measurements from the railroad bridge, as it is a narrow deck bridge 136 feet above the bed of the river. The initial point for discharge measurements is at the east end of the railway bridge. The

channel is straight for about 2,000 feet above and below the station, and the current is moderate at ordinary and swift at high stages. Both banks are high, rocky, clean, and do not overflow. The bed of the stream is composed of clean sand, and is shifting. The bench mark is the 4.5 foot gage mark on the concrete pier on the side facing the river. At low water there are three channels and at high water one, except as broken by 7 bridge piers.

During the floods of October 1, 1904, the lower section of the original gage was buried by sand, and the channel changed to the west side of the river. The upper section of the gage is to be destroyed, as the railway bridge will have to be rebuilt. A plain, vertical, staff gage has been attached to a temporary highway bridge about 750 feet below the old gage. This bridge will likely stay in place until the new railway bridge is built, unless washed out by floods. The new gage is graduated to feet and tenths from zero to 8 feet, with its zero placed 4.32 feet below the zero of the old gage. It was necessary to place this zero below the other, or have both positive and negative readings. Bench mark No. 1 is the top of a projecting point on a sandstone ledge about 100 feet north of the north end of the highway bridge, marked with a cross and the letters "B. M." Its elevation is 22.15 feet above the zero of the old gage. Bench mark No. 2 is a cross, marked "B. M.," on the top of a point of rock about 100 feet east of the second steel bent of the railway bridge, 115 feet south of the north end. Its elevation is 23.55 feet above the zero of the old gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of South Canadian River near Logan, N. Mex., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| June 29 | W. G. Russell | 245 | 64 | 0.87 | 0.55 | 56 |
| August 10 | do | 388 | 1,400 | [a] 5.32 | 4.50 | 7,446 |
| October 2 | do | | 13,520 | 11.05 | 31.30 | 149,400 |
| October 22 | do | 119 | 174 | [b] 3.72 | 3.00 | 647 |

[a] Float measurement velocity obtained from slope. [b] Float measurement.

*Mean daily gage height, in feet, of South Canadian River near Logan, N. Mex., for 1904.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| 1 | 1.50 | 1.50 | 0.40 | 30.00 | 2.70 | 2.0 |
| 2 | 2.00 | 5.00 | .45 | (a) | 2.60 | 2.0 |
| 3 | 3.00 | 4.00 | 3.25 | ..... | 2.55 | 2.0 |
| 4 | 3.50 | 2.50 | 3.05 | ..... | 2.45 | 2.0 |
| 5 | 2.50 | 1.50 | 1.75 | ..... | 2.40 | 2.0 |
| 6 | 1.90 | 1.00 | .90 | ..... | 2.40 | 2.0 |
| 7 | 1.30 | 1.40 | .70 | ..... | 2.50 | 2.2 |
| 8 | 2.00 | 1.00 | .60 | ..... | 2.50 | 2.2 |
| 9 | 2.80 | 3.50 | .55 | ..... | 2.50 | 2.2 |
| 10 | 1.60 | 4.50 | .50 | ..... | 2.50 | 2.1 |
| 11 | 1.30 | 3.50 | .50 | ..... | 2.50 | 2.1 |
| 12 | 3.50 | 1.20 | .50 | ..... | 2.40 | 2.1 |
| 13 | 1.10 | .80 | .45 | ..... | 2.40 | 2.0 |
| 14 | 1.30 | .60 | .40 | ..... | 2.40 | 2.0 |
| 15 | .80 | .60 | .40 | ..... | 2.40 | 2.0 |
| 16 | .60 | .55 | .40 | ..... | 2.30 | 2.0 |
| 17 | .50 | 3.35 | .40 | ..... | 2.30 | 2.0 |
| 18 | 3.30 | 2.25 | .30 | ..... | 2.20 | 2.0 |
| 19 | 1.50 | 1.60 | .30 | ..... | 2.10 | 2.0 |
| 20 | 2.00 | 1.20 | .30 | ..... | 2.10 | 2.1 |
| 21 | 1.00 | .95 | .20 | ..... | 2.10 | 2.2 |
| 22 | 3.35 | 1.80 | .20 | ..... | 2.00 | 2.2 |
| 23 | 3.00 | 1.85 | .20 | b 3.00 | 2.00 | 2.2 |
| 24 | 1.70 | 1.20 | .20 | 2.90 | 2.00 | 2.0 |
| 25 | 1.30 | .75 | .45 | 2.85 | 2.00 | 2.0 |
| 26 | 1.00 | .70 | .80 | 2.80 | 2.00 | 2.3 |
| 27 | 1.70 | .55 | 2.35 | 2.75 | 2.00 | 2.3 |
| 28 | 1.20 | .50 | 4.25 | 2.75 | 2.00 | 2.2 |
| 29 | 1.40 | .50 | 7.50 | 2.70 | 2.00 | 2.2 |
| 30 | .90 | .40 | 25.00 | 2.70 | 2.00 | 2.1 |
| 31 | 1.80 | .40 | ..... | 2.70 | ..... | 2.0 |

a Gage destroyed October 2. b Gage reestablished.

## MORA RIVER AT LA CUEVA, N. MEX.

This station was established August 25, 1903, by M. C. Hinderlider. It is located at the wagon bridge in the town of La Cueva, N. Mex. The gage is a vertical rod, graduated to feet and tenths from zero to 7 feet, fastened to the west end of the north abutment of the wagon bridge. The zero of the rod is on the bed of the stream. The gage is read twice each day by Hugh Loudon, of the La Cueva Land and Cattle Company. Discharge measurements are made by wading just below the bridge to which the gage is attached or from the bridge at high stages. The channel is tortuous above and below the station. The right bank is a high, rocky bluff. The left bank is a loam bank about 6 feet high, lined with willows and covered with alfalfa fields, and overflows at high water. The bed of the stream is composed of sand and gravel, and is somewhat shifting. There is but one channel except at very high stages, when the left bank is overflowed. Con-

ditions are favorable for good results. Practically all the water is diverted by the La Cueva canal just above the station, but is returned below. Gagings are made in the canal to determine the amount of water carried. During the flood of September 29, 1904, the bridge and gage were carried away. Records were discontinued for the remainder of the year, but the station will be reestablished in the spring of 1905.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Mean daily gage height, in feet, of Mora River at La Cueva, N. Mex., for 1904.*

| Day. | June. | July. | Day. | June. | July. | Day. | June. | July. | Day. | June. | July. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 0.80 | 9 | ..... | 0.70 | 17 | 0.90 | 0.30 | 25 | 0.75 | 1.25 |
| 2 | ..... | .70 | 10 | ..... | .70 | 18 | .70 | .30 | 26 | 1.05 | 1.25 |
| 3 | ..... | .85 | 11 | ..... | .65 | 19 | .75 | .80 | 27 | .85 | 1.25 |
| 4 | ..... | .75 | 12 | ..... | .75 | 20 | .70 | .70 | 28 | .80 | 1.25 |
| 5 | ..... | .70 | 13 | ..... | .60 | 21 | .70 | .65 | 29 | .65 | 1.20 |
| 6 | ..... | .70 | 14 | ..... | .50 | 22 | .85 | .75 | 30 | .65 | 1.15 |
| 7 | ..... | .60 | 15 | 0.55 | .50 | 23 | .80 | 1.45 | 31 | ..... | ..... |
| 8 | ..... | .60 | 16 | 1.10 | .35 | 24 | .80 | 1.10 | | | |

## MORA CANAL AT LA CUEVA, N. MEX.

Mora canal diverts water from Mora River a short distance above the gaging station maintained on Mora River at La Cueva, N. Mex., and returns a portion of the same below the station. At times a portion or all of the water in the canal is passed through the wheel of a grist mill or waste gate directly back to the river above the gage. At other times a portion or all the water in the canal is carried to storage reservoirs and not returned to the river. Gagings are made from the footbridge crossing the canal just north of the Mora River gaging station in order to determine the total amount of water carried by the river when water in the canal is being stored. The gage is a vertical staff, graduated to feet and tenths from zero to 2.9 feet, set at the right bank of the canal opposite the store building. The zero of the gage rests on the bottom of the canal. The gage is read twice each day by Hugh Loudon, of the La Cueva Land and Cattle Company. The bench mark is a cross marked with the letters "B. M." chiseled into one of the foundation stones of the store building, 1 foot above the ground and almost opposite the gage rod. Its elevation is 7.008 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Mean daily gage height, in feet, of Mora canal at La Cueva, N. Mex., for 1904.*

| Day. | June. | July. | Day. | June. | July. | Day. | June. | July. | Day. | June. | July. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 0.70 | 9 | ..... | 0.75 | 17 | 0.90 | 0.35 | 25 | 0.65 | 1.60 |
| 2 | ..... | .80 | 10 | ..... | .75 | 18 | .85 | .30 | 26 | 1.00 | 1.45 |
| 3 | ..... | .85 | 11 | ..... | .65 | 19 | .90 | .75 | 27 | .75 | 1.25 |
| 4 | ..... | .80 | 12 | ..... | .55 | 20 | .80 | .65 | 28 | .70 | .85 |
| 5 | ..... | .70 | 13 | ..... | .70 | 21 | .85 | .65 | 29 | .60 | .00 |
| 6 | ..... | .70 | 14 | ..... | .50 | 22 | .90 | 1.00 | 30 | .65 | .25 |
| 7 | ..... | .60 | 15 | 0.65 | .50 | 23 | .75 | 1.50 | 31 | ..... | ..... |
| 8 | ..... | .70 | 16 | .90 | .35 | 24 | .70 | 1.45 | | | |

## MORA RIVER AT WEBER, N. MEX.

This station was established August 21, 1903, by M. C. Hinderlider. It is located at the highway bridge 150 feet north of the post-office at Weber, N. Mex., and is about 15 miles west of Watrous, N. Mex. The gage is a vertical 2 by 6 inch timber 14 feet long, fastened to the upstream end of the south abutment of the wagon bridge. The zero of the gage rests on the bed of the river. It is read twice each day by Mrs. Emily Biernbaum, the postmaster at Weber. Discharge measurements are made during the greater part of the year by wading below the bridge. At high water they are made from the highway bridge which consists of a single span of 32 feet. The initial point for soundings is the edge of the left abutment. The channel is straight for 20 feet above and for 75 feet below the bridge. Both banks are of gravel and overflow only at high stages. The bed of the stream is composed of bowlders and mud, overlying shale or stone, with a sand bar near the right bank just below the bridge during low water. A few feet below the bridge the channel is filled across with riprap, is shifting, and free from vegetation. Bench mark No. 1 is a 20-penny nail driven horizontally into the northwest face of a large cottonwood tree 75 feet southeast of the gage. A spike is driven on each side of the bench mark. The elevation of the bench mark is 12.921 feet above the zero of the gage. Bench mark No. 2 is a 20-penny nail driven vertically into the top side of the east end of the cap timber of the north abutment of the bridge. Its elevation is 10.114 feet above the zero of the gage.

On September 29, 1904, this station was destroyed by the greatest flood ever known to have occurred on Mora River. The bridge and gage rod were carried away and all the buildings at Weber were destroyed. Since the flood this station has not been reestablished, as the observer moved away and no one else was available.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Discharge measurement of Mora River at Weber, N. Mex., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| October 12 | G. B. Monk | 37 | 73 | 2.71 | ([a]) | 198 |

[a] Gage destroyed September 30, 1904.

*Mean daily gage height, in feet, of Mora River at Weber, N. Mex., for 1904.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|
| 1 | 2.10 | 2.00 | 1.90 | 1.90 | 1.90 | 3.35 | 1.80 |
| 2 | 2.10 | 2.00 | 1.90 | 1.90 | 2.50 | 3.15 | 1.80 |
| 3 | 2.10 | 2.00 | 1.90 | 1.90 | 2.55 | 6.10 | 1.80 |
| 4 | 2.10 | 2.00 | 1.90 | 1.90 | 2.05 | 3.00 | 1.80 |
| 5 | 2.10 | 2.00 | 1.90 | 1.90 | 1.90 | 2.90 | 1.80 |
| 6 | 2.10 | 2.00 | 1.90 | 1.90 | 1.90 | 3.30 | 1.80 |
| 7 | 2.10 | 2.00 | 1.90 | 1.90 | 1.90 | 2.85 | 1.80 |
| 8 | 2.10 | 2.00 | 1.90 | 1.90 | 1.90 | 2.30 | 1.80 |
| 9 | 2.10 | 1.95 | 1.90 | 1.90 | 1.90 | 2.35 | 1.80 |
| 10 | 2.10 | 1.90 | 1.90 | 1.90 | 1.90 | 2.25 | 1.80 |
| 11 | 2.10 | 1.90 | 1.90 | 1.90 | 1.90 | 2.20 | 1.80 |
| 12 | 2.10 | 1.90 | 1.90 | 1.90 | 2.95 | 2.20 | 1.80 |
| 13 | 2.10 | 1.90 | 1.90 | 1.90 | 2.20 | 2.15 | 1.80 |
| 14 | 2.15 | 1.90 | 1.90 | 1.90 | 1.95 | 2.10 | 1.80 |
| 15 | 2.10 | 1.90 | 1.90 | 1.90 | 1.90 | 2.10 | 1.80 |
| 16 | 2.10 | 1.90 | 1.90 | 2.35 | 1.90 | 1.90 | 1.80 |
| 17 | 2.10 | 1.90 | 1.90 | 2.40 | 1.90 | 2.45 | 1.80 |
| 18 | 2.10 | 1.90 | 1.90 | 1.95 | 1.90 | 2.30 | 1.80 |
| 19 | 2.08 | 1.90 | 1.90 | 1.90 | 2.30 | 2.15 | 1.80 |
| 20 | 2.05 | 1.90 | 1.90 | 1.90 | 1.90 | 1.95 | 1.80 |
| 21 | 2.05 | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 | 1.90 |
| 22 | 2.05 | 1.90 | 2.25 | 2.10 | 2.35 | 1.90 | 1.90 |
| 23 | 2.05 | 1.95 | 1.90 | 1.90 | 3.30 | 1.85 | 2.00 |
| 24 | 2.05 | 2.00 | 1.90 | 1.90 | 2.55 | 1.80 | 1.90 |
| 25 | 2.05 | 2.00 | 1.90 | 1.85 | 3.80 | 1.75 | 1.90 |
| 26 | 2.00 | 1.90 | 1.90 | 1.80 | 2.90 | 1.65 | 1.85 |
| 27 | 2.00 | 1.90 | 1.90 | 2.00 | 3.00 | 1.60 | 2.50 |
| 28 | 2.00 | 1.90 | 1.90 | 2.20 | 2.95 | 1.70 | 3.65 |
| 29 | 2.00 | 1.90 | 1.90 | 1.95 | 2.40 | 1.70 | 8.50 |
| 30 | 2.00 | 1.90 | 1.90 | 1.90 | 2.35 | 1.80 | ([a]) |
| 31 | 2.00 | ..... | 1.90 | ..... | 2.30 | 1.80 | ..... |

[a] Gage destroyed September 30.

## SAPELLO RIVER AT SAPELLO, N. MEX.

This station was established August 12, 1903, by E. G. Marsh. It is located about one-half mile above the junction of Sapello and Manuelitos rivers, and is about 12 miles from Las Vegas, N. Mex. The gage is an inclined 1 by 8 inch pine board 10 feet long, bolted to the rock and braced with timbers. It is read once each day by Horace R. Titlow. Discharge measurements may be made by wading, but at high stages a cable, car, tagged wire, and stay wire will be necessary.

The initial point for soundings is a cross in the ledge of rock on the east bank. The channel is winding above and below the station, and will overflow both banks except at the station. The bed of the stream is composed of gravel above and below the station. At the station the bed is an outcrop of rock covered with about 6 inches of shifting sand. The bench mark consists of two arrows with the letters B. M. cut in the ledge of rock on the east bank 10 feet downstream from the gaging section. Its elevation is 12.57 feet above the zero of the gage.

This station was abandoned in March, 1904, being replaced by the station farther down the Sapello at Los Alamos. Owing to the great drought of 1903 no discharge measurements were made.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Mean daily gage height, in feet, of Sapello River at Sapello, N. Mex., for 1904.*

| Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.60 | 0.60 | 0.50 | 12 | 0.60 | 0.60 | 0.50 | 22 | 0.60 | 0.50 | 0.40 |
| 2 | .60 | .60 | .50 | 13 | .60 | .60 | .50 | 23 | .60 | .50 | .40 |
| 3 | .60 | .60 | .50 | 14 | .60 | .60 | .50 | 24 | .60 | .50 | .40 |
| 4 | .60 | .60 | .50 | 15 | .60 | .60 | .40 | 25 | .60 | .50 | .40 |
| 5 | .60 | .60 | .50 | 16 | .60 | .60 | .40 | 26 | .60 | .50 | .40 |
| 6 | .60 | .60 | .50 | 17 | .60 | .60 | .40 | 27 | .60 | .50 | .40 |
| 7 | .60 | .60 | .50 | 18 | .60 | .60 | .40 | 28 | .60 | .50 | .40 |
| 8 | .60 | .60 | .50 | 19 | .60 | .50 | .40 | 29 | .60 | .50 | .40 |
| 9 | .60 | .60 | .50 | 20 | .60 | .50 | .40 | 30 | .60 | ..... | .40 |
| 10 | .60 | .60 | .50 | 21 | .60 | .50 | .40 | 31 | .60 | ..... | .40 |
| 11 | .60 | .60 | .50 | | | | | | | | |

## SAPELLO RIVER NEAR LOS ALAMOS, N. MEX.

This station was established August 22, 1903, by M. C. Hinderlider. It is located at a ford crossing Sapello River at a point due north from Los Alamos and about one-fourth mile distant. The gage consists of a 2 by 6 inch timber, 16 feet long, placed in an inclined position on the right bank of the river at the ford. It is graduated to read directly to vertical tenths of feet from 0.5 foot to 7.5 feet. There is no bridge and no other means of making high-water measurements. This station later took the place of the stations on the Sapello and Manuelitos rivers at Sapello when the latter were abandoned in March, 1904. All measurements are made by wading. The initial point for soundings is the right bank. The channel is straight for 200 feet above and below the station. The current is moderate at ordinary stages and rapid at flood stages. The right bank is high and steep and does not overflow at the gage. The left bank is a low sand and gravel bar extending for about 100 feet and then rising to above high-water mark. The bed of the stream is composed of small cobblestones, gravel, and sand, and is apparently permanent. The

cross section is regular, and there is one channel at all stages. The bench mark is a 20-penny spike driven horizontally into the northwest face of a 10-inch willow tree about 3½ feet above the ground. The tree is about 100 feet southeast of the gage, and there is a spike driven on each side of the bench mark. The elevation of the bench mark is 17.815 feet above the zero of the gage. The gage is read twice each day by W. B. Hogin.

A cable was placed across this stream about 500 feet above the gage rod, equipped with car and tag wire, in March, 1904, from which gagings at high stages are made. This station was established for the purpose of determining the available amount of water for prospective diversion into the Sanguyjuella basin for storage. This basin lies about 6 miles northwest of Las Vegas.

The following discharge measurement was made by M. C. Hinderlider in 1903:

August 22: Gage height, 1.30 feet; discharge, 7 second-feet.

No other measurements were secured in 1903 on account of the extremely low stage of this stream during the entire year. For the same reason but one discharge measurement was made in 1904, which was made by George B. Monk:

October 12: Discharge, 137 second-feet.

This measurement was made after the great flood of September 29, 1904, which destroyed the gage. The gage will be reestablished in the spring of 1905.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Mean daily gage height, in feet, of Sapello River near Los Alamos, N. Mex., for 1904.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|
| 1 | ..... | 1.00 | 1.00 | 1.10 | 1.00 | 1.30 | 1.00 |
| 2 | ..... | 1.00 | 1.00 | 1.10 | 1.00 | 1.30 | 1.00 |
| 3 | ..... | 1.00 | 1.00 | 1.10 | 1.00 | 2.30 | 1.00 |
| 4 | ..... | 1.00 | 1.00 | 1.10 | 1.00 | 2.20 | 1.00 |
| 5 | ..... | 1.00 | 1.00 | 1.10 | 1.00 | 1.95 | 1.00 |
| 6 | 1.00 | 1.00 | 1.00 | 1.10 | 1.00 | 2.75 | 1.00 |
| 7 | 1.00 | 1.00 | 1.00 | 1.10 | 1.00 | 2.20 | 1.00 |
| 8 | 1.00 | 1.00 | 1.00 | 1.10 | 1.00 | 2.30 | 1.00 |
| 9 | 1.00 | 1.00 | 1.00 | 1.10 | 1.00 | 2.40 | 1.00 |
| 10 | 1.00 | 1.00 | 1.00 | 1.10 | 1.00 | 2.30 | 1.00 |
| 11 | 1.00 | 1.00 | 1.00 | 1.10 | 1.00 | 1.70 | 1.00 |
| 12 | 1.00 | 1.00 | 1.00 | 1.35 | 1.00 | 1.25 | 1.00 |
| 13 | 1.00 | 1.00 | 1.00 | 2.55 | 1.00 | 1.00 | 1.00 |
| 14 | 1.00 | 1.00 | 1.00 | 3.20 | 1.00 | 1.00 | 1.00 |
| 15 | 1.00 | 1.00 | 1.00 | 2.40 | 1.00 | 1.00 | 1.00 |
| 16 | 1.00 | 1.00 | 1.00 | 2.55 | 1.00 | 1.00 | 1.00 |
| 17 | 1.00 | 1.00 | 1.00 | 2.60 | 1.00 | 1.00 | 1.00 |
| 18 | 1.00 | 1.00 | 1.00 | 1.35 | 1.00 | 2.25 | 1.00 |
| 19 | 1.00 | 1.00 | 1.10 | 1.20 | 1.00 | 1.30 | 1.00 |
| 20 | 1.00 | 1.00 | 1.10 | 1.05 | 1.00 | 1.00 | 1.00 |
| 21 | 1.00 | 1.00 | 1.20 | 1.00 | 1.00 | 1.00 | 1.00 |
| 22 | 1.00 | 1.00 | 2.70 | 1.00 | 1.00 | 1.00 | 1.00 |
| 23 | 1.00 | 1.00 | 2.15 | 1.00 | 1.95 | 1.00 | 1.00 |
| 24 | 1.00 | 1.00 | 1.40 | 1.00 | 2.10 | 1.00 | 1.00 |
| 25 | 1.00 | 1.00 | 1.15 | 1.00 | 1.65 | 1.00 | 1.00 |
| 26 | 1.00 | 1.00 | 1.10 | 1.00 | 1.80 | 1.00 | 1.00 |
| 27 | 1.00 | 1.00 | 1.10 | 1.00 | 2.05 | 1.00 | 1.00 |
| 28 | 1.00 | 1.00 | 1.10 | 1.00 | 1.50 | 1.00 | 5.90 |
| 29 | 1.00 | 1.00 | 1.10 | 1.00 | 1.30 | 1.00 | (a) |
| 30 | 1.00 | 1.00 | 1.10 | 1.00 | 1.30 | 1.00 | ..... |
| 31 | 1.00 | ..... | 1.10 | ..... | 1.30 | 1.00 | ..... |

a Gage destroyed by flood.

## SAPELLO MILL TAILRACE AT SAPELLO, N. MEX.

A gage rod was placed in the mill tailrace of the flouring mill at Sapello, for the purpose of determining the amount of water passing through the mill wheel. This water is diverted by two ditches from both Sapello and Manuelitos rivers at points above the gage rods in those streams, and reenters Sapello River below the junction of Sapello and Manuelitos rivers. At low stages these ditches take the entire supply in the two rivers before the water reaches the gage rods in the same, and as this water is returned to the river below the gage rods through the mill tailrace it was necessary to place a gage in the mill tailrace. This gage consists of a 2 by 4 inch by 5-foot timber graduated to vertical feet and tenths and placed in the mill tailrace about 150 feet below the mill. The amount of water passing this gage, added to the amount passing the gages in Sapello and Manuelitos rivers, gives the total discharge of the Sapello proper. This station, with the sta-

tions on the Sapello and Manuelitos rivers at Sapello, was abandoned in March, 1904.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Mean daily gage height, in feet, of Sapello Mill tailrace at Sapello, N. Mex., for 1904.*

| Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.30 | 0.30 | 0.80 | 12 | 0.30 | 0.30 | 0.30 | 23 | 0.30 | 0.80 | 0.40 |
| 2 | .30 | .30 | .80 | 13 | .30 | .30 | .30 | 24 | .30 | .90 | .00 |
| 3 | .30 | .30 | .80 | 14 | .30 | .30 | .00 | 25 | .30 | .90 | .00 |
| 4 | .30 | .30 | .80 | 15 | .30 | .30 | .00 | 26 | .30 | .90 | .00 |
| 5 | .30 | .30 | .80 | 16 | .30 | .30 | .00 | 27 | .30 | .90 | .20 |
| 6 | .30 | .30 | .00 | 17 | .30 | .30 | .00 | 28 | .30 | .90 | .20 |
| 7 | .30 | .30 | .00 | 18 | .30 | .30 | .00 | 29 | .30 | .90 | .20 |
| 8 | .30 | .30 | .30 | 19 | .30 | .40 | .00 | 30 | .30 | ..... | .20 |
| 9 | .30 | .30 | .30 | 20 | .30 | .50 | .00 | 31 | .30 | ..... | .20 |
| 10 | .30 | .30 | .30 | 21 | .30 | .60 | .00 | | | | |
| 11 | .30 | .30 | .30 | 22 | .30 | .60 | .00 | | | | |

## MANUELITOS RIVER AT SAPELLO, N. MEX.

This station was established August 11, 1903, by E. G. Marsh. It is located two-fifths of a mile above the junction of Sapello and Manuelitos rivers, and about 12 miles from Las Vegas, N. Mex. There is a riprap wing dam 500 feet below the station. The gage is a 1 by 8 inch pine board 10 feet long, bolted in an inclined position to the rocky bluff on the left bank, and is graduated to read to vertical tenths of feet. It is read once each day by Horace R. Titlow. A cable, car, and tagged wire will be necessary in order to obtain measurements at high water. The initial point for soundings is a cross cut in the face of the rock 5 feet downstream from the gage, on the east bank. The channel is straight for 100 feet above and 250 feet below the station. At flood stages the current is very swift and there is but one channel. At very low water there are several small channels. The right bank is low, brush lined, and overflows at high water until it reaches a second higher bank. The left bank is a steep, rocky bluff, and does not overflow. The bed of the stream is composed of quicksand, which is prevented from shifting by the riprap dam below. The bench mark consists of two arrows cut in the rocky bluff 39 feet downstream from the gage. Its elevation is 7.65 feet above the zero of the gage. This station was abandoned in March, 1904, and replaced by the one on Sapello River at Los Alamos.

The observations at this station during 1904 have been made under the direction of M. C. Hinderlider, district hydrographer.

*Mean daily gage height, in feet, of Manuelitos River at Sapello, N. Mex., for 1904.*

| Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.30 | 0.40 | 0.30 | 12 | 0.30 | 0.40 | 0.30 | 23 | 0.30 | 0.30 | 0.30 |
| 2 | .30 | .40 | .30 | 13 | .30 | .40 | .30 | 24 | .30 | .30 | .30 |
| 3 | .30 | .40 | .30 | 14 | .30 | .30 | .30 | 25 | .30 | .30 | .30 |
| 4 | .30 | .40 | .30 | 15 | .30 | .30 | .30 | 26 | .30 | .30 | .30 |
| 5 | .30 | .40 | .30 | 16 | .30 | .30 | .30 | 27 | .30 | .30 | .30 |
| 6 | .30 | .40 | .30 | 17 | .30 | .30 | .30 | 28 | .30 | .30 | .30 |
| 7 | .30 | .40 | .30 | 18 | .30 | .30 | .30 | 29 | .30 | .30 | .30 |
| 8 | .30 | .40 | .30 | 19 | .30 | .30 | .30 | 30 | .30 | .30 | .30 |
| 9 | .30 | .40 | .30 | 20 | .30 | .30 | .30 | 31 | .30 | .30 | .30 |
| 10 | .30 | .40 | .30 | 21 | .30 | .30 | .30 | | | | |
| 11 | .30 | .40 | .30 | 22 | .30 | .30 | .30 | | | | |

## UTE CREEK NEAR LOGAN, N. MEX.

This station was established August 12, 1904, by W. G. Russell. It is located about 7 miles northwest of Logan, N. Mex., and about 4 miles above the mouth of Ute Creek, near the old Martinez house. An inclined staff gage, graduated to read in vertical feet and tenths from zero to 7 feet, is fastened to the point of rocks about 100 yards northwest of the old Martinez house. The graduations are continued up to 11 feet on the rock. The gage is read once each day by Manuel Martinez. Discharge measurements are made at low water by wading near the gage. Discharges for high stages must be computed from the slope and cross section. The initial point for soundings is at the gage, on the left bank of the stream. The channel is straight for about 300 feet above the station. The current is sluggish at low and swift at high stages. The right bank is low, clean, and subject to overflow. The left bank is high, rocky, wooded, and does not overflow. The bed of the stream is composed of clean sand, and is shifting. There is but one channel at all stages. The bench mark is a cross painted on the top of a rock on the left bank, 100 feet below the gage. Its elevation is 5.51 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Mean daily gage height, in feet, of Ute Creek near Logan, N. Mex., for 1904.*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | ..... | 2.50 | 0.10 | 0.10 | 17 | 5.50 | 0.40 | 0.30 | 0.10 | 0.20 |
| 2 | ..... | 9.00 | 2.20 | .10 | .10 | 18 | 2.30 | .40 | .30 | .10 | .20 |
| 3 | ..... | 5.50 | 2.00 | .10 | .10 | 19 | 2.10 | .30 | .30 | .10 | .20 |
| 4 | ..... | 3.50 | 1.60 | .10 | .10 | 20 | 1.30 | .30 | .20 | .10 | .20 |
| 5 | ..... | 2.00 | 1.30 | .10 | .20 | 21 | 1.20 | .30 | .20 | .10 | .20 |
| 6 | ..... | 1.10 | 1.00 | .10 | .20 | 22 | 1.10 | .30 | .20 | .10 | .20 |
| 7 | ..... | .80 | .80 | .10 | .30 | 23 | 1.00 | .30 | .20 | .10 | .20 |
| 8 | ..... | .50 | .50 | .10 | .30 | 24 | .90 | .30 | .20 | .10 | .20 |
| 9 | ..... | .40 | 1.00 | .10 | .30 | 25 | .80 | .20 | .20 | .10 | .20 |
| 10 | ..... | .20 | .90 | .10 | .30 | 26 | .70 | .20 | .10 | .10 | .20 |
| 11 | ..... | .30 | .90 | .10 | .30 | 27 | .60 | .20 | .10 | .10 | .20 |
| 12 | ..... | .40 | .80 | .10 | .20 | 28 | (a) | 3.50 | .10 | .10 | .20 |
| 13 | ..... | .40 | .70 | .10 | .20 | 29 | ..... | 5.00 | .10 | .10 | .20 |
| 14 | 0.30 | .40 | .50 | .10 | .20 | 30 | ..... | 3.00 | .10 | .10 | .20 |
| 15 | .30 | .40 | .30 | .10 | .20 | 31 | ..... | ..... | .10 | ..... | .20 |
| 16 | .30 | .40 | .30 | .10 | .20 | | | | | | |

a Creek dry August 28 to September 1, inclusive.

## BEAVER CREEK NEAR BEAVER, OKLA.

This station was established March 29, 1904, by W. G. Russell. It is located just below the ford about one-fourth mile north of Beaver, Okla. The gage is an inclined 1 by 4 inch rod 12 feet long, graduated to feet and tenths from zero to 5.5 feet, spiked to two locust fence posts driven 5 feet into the right bank and bed of the river. It is read once each day by Logan Rock. Discharge measurements are made at low water by wading. It is not possible to make high-water measurements in this vicinity, and the discharge during floods must be computed from the slope and cross section. The initial point for soundings is at the gage. The channel is straight for about 300 feet above and below the station and about 95 feet wide at ordinary stages. During the flood of July, 1904, the river was 2,547 feet wide along the highway and across the ford, and the stream bed was eroded. The old gage was destroyed July 9, 1904, and a new one was placed a short distance downstream at the same elevation. The current is sluggish at low water, but has a good current at high stages. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at all stages. The bench mark is the top of a pine stake about 0.5 feet above the surface of the ground 15 feet south of the gage. Its elevation is 5.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements on Beaver Creek near Beaver, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 29 | W. G. Russell | 55 | 23 | 0.91 | 1.15 | 21 |
| August 3 | do | 95 | 77 | 1.77 | .82 | [a] 136 |

[a] Old gage destroyed July 9, 1904, and new gage was placed a short distance downstream at the same elevation. The flood cut the bed out and left water surface at lower elevation.

*Mean daily gage height, in feet, of Beaver Creek near Beaver, Okla., for 1904.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 1.10 | 1.50 | 1.10 | 1.50 | ..... | 0.40 | 0.70 | 0.75 | 0.75 |
| 2 | ..... | 1.15 | 1.60 | 1.10 | 1.30 | ..... | .35 | 2.60 | .75 | .75 |
| 3 | ..... | 1.15 | 2.60 | 1.15 | 1.30 | 0.80 | .35 | 3.15 | .75 | .75 |
| 4 | ..... | 1.20 | 2.40 | 1.10 | 1.50 | .70 | .35 | 2.00 | .70 | .75 |
| 5 | ..... | 1.20 | 1.80 | 1.10 | 1.50 | 1.90 | .35 | 1.70 | .75 | .75 |
| 6 | ..... | 1.25 | 1.60 | 1.15 | 1.40 | 1.40 | .40 | 1.30 | .75 | .60 |
| 7 | ..... | 1.25 | 1.50 | 1.10 | 4.10 | 1.10 | .35 | 1.15 | .75 | .60 |
| 8 | ..... | 1.25 | 1.35 | 1.10 | 4.80 | .90 | .35 | 1.15 | .75 | .65 |
| 9 | ..... | 1.25 | 1.30 | 2.17 | ..... | .70 | .35 | 1.00 | .70 | .65 |
| 10 | ..... | 1.20 | 1.30 | 1.90 | ..... | .65 | .35 | .90 | .70 | .65 |
| 11 | ..... | 1.20 | 1.35 | 1.50 | ..... | .60 | .40 | .90 | .70 | .70 |
| 12 | ..... | 1.15 | 1.30 | 1.40 | ..... | 1.40 | .40 | .85 | .70 | .70 |
| 13 | ..... | 1.15 | 1.20 | 1.35 | ..... | 1.10 | .90 | .75 | .70 | .90 |
| 14 | ..... | 1.15 | 1.20 | 1.30 | ..... | 1.05 | .90 | .65 | .70 | .90 |
| 15 | ..... | 1.15 | 1.20 | 1.25 | ..... | .90 | .80 | 1.50 | .70 | .90 |
| 16 | ..... | 1.15 | 1.20 | 1.20 | ..... | .95 | .70 | 1.40 | .65 | .90 |
| 17 | ..... | 1.10 | 1.20 | 1.15 | ..... | .55 | .50 | 1.30 | .65 | 1.00 |
| 18 | ..... | 1.10 | 1.15 | 1.10 | ..... | .60 | .45 | 1.30 | .65 | .95 |
| 19 | ..... | 1.10 | 1.10 | 1.10 | ..... | .60 | .30 | 1.25 | .65 | .90 |
| 20 | ..... | 1.15 | 1.10 | 2.30 | ..... | .55 | .30 | 1.00 | .65 | .90 |
| 21 | ..... | 1.10 | 1.10 | 1.40 | ..... | .90 | .30 | 1.00 | .70 | .85 |
| 22 | ..... | 1.10 | 1.10 | 1.20 | ..... | 1.10 | .25 | .95 | .65 | .85 |
| 23 | ..... | 1.10 | 1.10 | 1.20 | ..... | .80 | .25 | .90 | .65 | .80 |
| 24 | ..... | 1.10 | 1.10 | 1.30 | ..... | .75 | .30 | .90 | .65 | .80 |
| 25 | ..... | 1.10 | 1.10 | 1.30 | ..... | .70 | .30 | .90 | .65 | .80 |
| 26 | ..... | 1.15 | 1.10 | 1.25 | ..... | .60 | .30 | .85 | .65 | .80 |
| 27 | ..... | 1.15 | 1.15 | 1.30 | ..... | .55 | .30 | .80 | .70 | .80 |
| 28 | ..... | 1.10 | 1.15 | 1.40 | ..... | .50 | .25 | .80 | .70 | .80 |
| 29 | 1.15 | 1.20 | 1.15 | 1.70 | ..... | .40 | .25 | .75 | .75 | .90 |
| 30 | 1.15 | 1.25 | 1.10 | 1.70 | ..... | .40 | .30 | .75 | .75 | 1.00 |
| 31 | 1.10 | ..... | 1.10 | ..... | ..... | .45 | ..... | .75 | ..... | 1.10 |

## CANADIAN RIVER (NORTH FORK) NEAR WOODWARD, OKLA.

This station was established September 13, 1903, by W. G. Russell. It is located 7 miles east of Woodward, at the railroad bridge. The gage is painted on the west face of the second pier from the west end of the bridge. It reads from zero to 7 feet. The observer is Adolph Mueller, the section foreman. Discharge measurements are made from the six-span railroad bridge, which has a total length between abutments of 360 feet. The initial point for soundings is the west end

of the bridge. The channel is straight for 200 feet above and below the station. The right bank is high and not liable to overflow. The left bank is low and liable to overflow, with scattering trees along the bank. The bed of the stream is sandy and shifting. There is one channel, broken by two piers at low water and five piers at high water. The bench mark is the bottom of the coping stone of the pier at the top of the gage. Its elevation is 7.00 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of W. G. Russell, resident hydrographer.

*Discharge measurements of Canadian River (North Fork) near Woodward, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| August 18 | W. G. Russell | 140 | 263 | 0.98 | 2.20 | 258 |
| September 18 | do | 82 | 41 | 1.85 | 1.70 | 76 |

*Mean daily gage height, in feet, of Canadian River (North Fork) near Woodward, Okla., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.50 | 2.60 | 2.60 | 2.40 | 5.00 | 2.00 | 2.20 | ..... | 2.00 | 1.70 | 2.10 | 2.10 |
| 2 | 2.40 | 2.60 | 2.60 | 2.30 | 3.20 | 2.00 | 2.40 | ..... | 2.00 | 1.90 | 2.10 | 2.10 |
| 3 | 2.50 | 2.50 | 2.60 | 2.40 | 3.00 | 2.00 | 2.30 | ..... | 2.00 | 1.90 | 2.10 | 2.10 |
| 4 | 2.50 | 2.70 | 2.50 | 2.40 | 7.00 | 2.00 | 2.30 | ..... | 1.80 | 3.70 | 2.10 | 2.20 |
| 5 | 2.50 | 2.80 | 2.60 | 2.50 | 3.60 | 2.00 | 2.50 | ..... | 1.80 | 2.90 | 2.10 | 2.20 |
| 6 | 2.50 | 2.70 | 2.60 | 2.40 | 3.50 | 2.00 | 2.50 | ..... | 1.70 | 2.70 | 2.10 | 2.40 |
| 7 | 2.50 | 2.60 | 2.50 | 2.40 | 3.40 | 2.00 | 3.00 | ..... | 1.60 | 2.70 | 2.10 | 2.50 |
| 8 | 2.50 | 2.70 | 2.50 | 2.40 | 3.00 | 2.00 | 7.80 | ..... | 1.60 | 2.60 | 2.10 | 2.40 |
| 9 | 2.40 | 2.70 | 2.50 | 2.40 | 2.90 | 2.00 | 7.70 | ..... | 1.60 | 2.40 | 2.10 | 2.40 |
| 10 | 2.60 | 2.60 | 2.50 | 2.40 | 2.70 | 2.30 | 7.00 | ..... | 1.60 | 2.40 | 2.10 | 2.40 |
| 11 | 2.70 | 2.50 | 2.50 | 2.40 | 2.50 | 4.50 | 4.50 | ..... | 1.50 | 2.40 | 2.10 | 2.40 |
| 12 | 2.50 | 2.50 | 2.50 | 2.40 | 2.40 | 3.70 | 4.00 | ..... | 2.00 | 2.30 | 2.10 | 2.40 |
| 13 | 2.60 | 2.50 | 2.50 | 2.40 | 2.40 | 3.20 | 3.50 | ..... | 1.90 | 2.30 | 2.10 | 2.40 |
| 14 | 2.50 | 2.90 | 2.50 | 2.40 | 2.30 | 3.00 | 3.00 | ..... | 1.90 | 2.20 | 2.10 | 2.40 |
| 15 | 2.50 | 2.60 | 2.50 | 2.40 | 2.30 | 2.70 | 3.00 | ..... | 1.80 | 2.20 | 2.10 | 2.40 |
| 16 | 2.50 | 2.60 | 2.50 | 2.30 | 2.60 | 2.60 | 3.00 | ..... | 1.80 | 2.10 | 2.10 | 2.40 |
| 17 | 2.70 | 2.80 | 2.50 | 2.20 | 2.60 | 2.60 | 2.80 | ..... | 1.80 | 2.10 | 2.10 | 2.40 |
| 18 | 2.60 | 2.30 | 2.40 | 2.20 | 2.60 | 2.60 | 2.80 | ..... | 1.70 | 2.10 | 2.10 | 2.20 |
| 19 | 2.50 | 2.70 | 2.50 | 2.20 | 2.60 | 2.30 | 2.60 | ..... | 1.70 | 2.10 | 2.10 | 2.10 |
| 20 | 2.50 | 2.60 | 2.60 | 2.30 | 2.10 | 2.30 | 2.60 | ..... | 1.80 | 2.10 | 2.10 | 2.20 |
| 21 | 2.50 | 2.90 | 2.50 | 2.30 | 2.30 | 2.30 | 2.40 | 2.30 | 1.80 | 2.10 | 2.10 | 2.40 |
| 22 | 2.50 | 2.70 | 2.50 | 2.20 | 2.20 | 2.10 | 2.70 | 2.30 | 1.80 | 2.10 | 2.10 | 2.60 |
| 23 | 2.50 | 2.70 | 2.50 | 2.20 | 2.00 | 2.30 | 2.60 | 2.70 | 1.80 | 2.10 | 2.10 | 2.50 |
| 24 | 2.50 | 2.70 | 2.50 | 2.20 | 2.10 | 2.40 | 2.50 | 2.50 | 1.80 | 2.10 | 2.10 | 2.40 |
| 25 | 2.60 | 2.70 | 2.50 | 2.20 | 2.60 | 2.30 | 2.40 | 2.40 | 1.80 | 2.10 | 2.10 | 2.30 |
| 26 | 2.40 | 2.70 | 2.40 | 2.20 | 2.10 | 2.30 | 2.40 | 2.30 | 1.80 | 2.10 | 2.10 | 2.30 |
| 27 | 2.50 | 2.60 | 2.40 | 2.20 | 2.10 | 2.50 | 2.50 | 2.20 | 1.70 | 2.10 | 2.10 | 2.30 |
| 28 | 2.50 | 2.70 | 2.40 | 2.20 | 2.10 | 2.40 | 2.50 | 2.30 | 1.70 | 2.10 | 2.10 | 2.30 |
| 29 | 2.60 | 2.60 | 2.40 | 2.20 | 2.10 | 2.40 | 2.40 | 2.20 | 1.70 | 2.10 | 2.10 | 2.30 |
| 30 | 2.60 | ..... | 2.40 | 2.40 | 2.10 | 2.40 | 2.30 | 2.20 | 1.70 | 2.10 | 2.10 | 2.30 |
| 31 | 2.70 | ..... | 2.40 | ..... | 2.10 | ..... | ..... | 2.20 | ..... | 2.10 | ..... | 2.30 |

## CANADIAN RIVER (NORTH FORK) NEAR EL RENO, OKLA.

This station was established October 27, 1902, by W. G. Russell, and is located at the highway bridge, 2 miles north of El Reno, Okla. The gage is of the usual wire type, with a scaleboard graduated to feet and tenths, and nailed to the railing of the bridge. The distance from the end of the weight to the marker is 17.06 feet. The bench mark is the top of a steel cylinder on the north side of the bridge. Its elevation is 11.30 feet above the zero of the gage. The initial point for soundings is on the right bank. The channel both above and below the station is straight for about 200 feet and has a width of 30 feet. The right bank is high and the left bank is low. Both banks are liable to overflow. The bed of the stream is sandy and somewhat shifting. The observer is Kenneth A. Killion, who reads the gage once daily. The gage was destroyed July 6, 1903, but was reestablished July 10.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

*Discharge measurements of Canadian River (North Fork) near El Reno, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| January 24 [a] | E. R. Kerby | 101 | 101 | 0.65 | 2.80 | 66 |
| May 4 | do | 106 | 244 | 2.25 | 4.10 | 547 |
| June 7 | do | 101 | 109 | 1.73 | 2.90 | 187 |
| July 24 | do | 116 | 677 | 2.60 | 6.55 | 1,764 |
| August 31 | do | 68 | 101 | 1.85 | 3.10 | 184 |
| September 21 | do | 53 | 55 | 1.63 | 2.60 | 89 |
| October 18 | do | 59 | 88 | 1.63 | 3.00 | 143 |

[a] Float measurement.

*Mean daily gage height, in feet, of Canadian River (North Fork) near El Reno, Okla., for 1904.*

| Day. | Jan.[a] | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.90 | 2.00 | 2.30 | 2.00 | 2.40 | 2.80 | 2.80 | 3.90 | 3.00 | 2.30 | 2.60 | 2.60 |
| 2 | 1.80 | 2.00 | 2.30 | 2.00 | 2.30 | 2.70 | 2.80 | 3.60 | 3.00 | 2.30 | 2.70 | 2.60 |
| 3 | 1.80 | 2.00 | 2.30 | 2.00 | 3.50 | 5.70 | 5.10 | 3.70 | 2.90 | 2.40 | 2.70 | 2.60 |
| 4 | 1.80 | 2.00 | 2.30 | 2.00 | 4.10 | 6.00 | 3.80 | 3.60 | 2.90 | 2.80 | 2.70 | 2.60 |
| 5 | 1.80 | 2.00 | 2.30 | 2.00 | 7.90 | 3.90 | 3.20 | 3.60 | 2.80 | 2.60 | 2.70 | 2.60 |
| 6 | 1.80 | 2.10 | 2.30 | 2.00 | 8.60 | 3.40 | 3.10 | 3.50 | 2.80 | 2.40 | 2.70 | 2.50 |
| 7 | 1.80 | 2.00 | 2.20 | 2.00 | 8.90 | 2.90 | 2.90 | 3.60 | 2.80 | 2.30 | 2.70 | 2.50 |
| 8 | 1.80 | 2.20 | 2.20 | 2.00 | 5.70 | 3.00 | 2.90 | 3.50 | 2.70 | 2.30 | 2.60 | 2.50 |
| 9 | 1.90 | 2.20 | 2.20 | 2.00 | 5.30 | 2.80 | 8.40 | 3.60 | 2.60 | 5.60 | 2.60 | 2.50 |
| 10 | 1.90 | 2.20 | 2.10 | 2.00 | 4.90 | 4.60 | 9.15 | 3.60 | 2.60 | 3.80 | 2.60 | 2.50 |
| 11 | 1.90 | 2.30 | 2.10 | 2.00 | 4.60 | 5.80 | 9.30 | 4.10 | 2.60 | 3.60 | 2.60 | 2.70 |
| 12 | 1.80 | 2.30 | 2.10 | 1.90 | 4.30 | 6.95 | 9.35 | 4.00 | 2.70 | 3.40 | 2.60 | 2.70 |
| 13 | 1.90 | 2.30 | 2.10 | 1.90 | 3.90 | 6.30 | 9.40 | 4.60 | 2.70 | 3.20 | 2.60 | 2.70 |
| 14 | 1.90 | 2.20 | 2.10 | 1.80 | 3.90 | 5.00 | 9.50 | 4.80 | 2.70 | 3.20 | 2.60 | 2.60 |
| 15 | 1.90 | 2.20 | 2.10 | 1.90 | 3.60 | 4.80 | 10.00 | 4.20 | 2.60 | 3.10 | 2.60 | 2.60 |
| 16 | 1.90 | 2.30 | 2.10 | 1.80 | 4.00 | 4.50 | 8.70 | 3.90 | 2.60 | 3.10 | 2.60 | 2.60 |
| 17 | 2.00 | 2.30 | 2.10 | 1.80 | 3.60 | 4.10 | 6.70 | 3.80 | 2.60 | 3.00 | 2.60 | 2.60 |
| 18 | 2.10 | 2.30 | 2.10 | 1.80 | 3.60 | 3.80 | 5.70 | 3.60 | 2.60 | 2.90 | 2.60 | 2.80 |
| 19 | 2.10 | 2.30 | 2.10 | 1.80 | 3.50 | 3.50 | 5.50 | 3.40 | 2.50 | 2.90 | 2.60 | 2.70 |
| 20 | 2.10 | 2.30 | 2.00 | 1.80 | 3.40 | 3.40 | 5.00 | 3.40 | 3.10 | 2.80 | 2.60 | 2.80 |
| 21 | 2.20 | 2.30 | 2.00 | 1.80 | 3.20 | 3.10 | 4.90 | 3.30 | 2.60 | 2.80 | 2.70 | 2.90 |
| 22 | 2.20 | 2.20 | 2.00 | 1.80 | 3.20 | 3.10 | 4.60 | 3.40 | 2.70 | 2.70 | 2.60 | 2.90 |
| 23 | 2.20 | 2.20 | 2.00 | 1.80 | 3.10 | 3.00 | 4.50 | 3.40 | 2.60 | 2.70 | 2.60 | 2.90 |
| 24 | 2.20 | 2.20 | 2.00 | 1.80 | 3.00 | 2.90 | 6.50 | 3.80 | 2.60 | 2.70 | 2.60 | 2.90 |
| 25 | 2.10 | 2.20 | 2.00 | 4.00 | 3.00 | 2.80 | 5.60 | 3.70 | 2.50 | 2.80 | 2.60 | 3.00 |
| 26 | 2.10 | 2.20 | 2.00 | 3.60 | 2.80 | 4.00 | 4.50 | 3.50 | 2.50 | 2.80 | 2.60 | 3.30 |
| 27 | 2.10 | 2.30 | 2.00 | 3.00 | 2.80 | 3.00 | 4.40 | 3.50 | 2.40 | 2.70 | 2.60 | 3.20 |
| 28 | 2.10 | 2.30 | 2.00 | 2.60 | 2.80 | 3.10 | 4.10 | 3.50 | 2.40 | 3.00 | 2.60 | 3.20 |
| 29 | 2.00 | 2.30 | 2.00 | 2.60 | 2.80 | 3.00 | 4.00 | 3.50 | 2.40 | 2.90 | 2.60 | 3.20 |
| 30 | 2.00 | ..... | 2.00 | 2.60 | 2.80 | 2.80 | 4.00 | 3.20 | 2.30 | 2.70 | 2.60 | 3.20 |
| 31 | 2.00 | ..... | 2.00 | ..... | 3.20 | ..... | 3.80 | 3.10 | ..... | 2.60 | ..... | 3.00 |

[a] River partly frozen during January.

*Rating table for Canadian River (North Fork) near El Reno, Okla., from October 27, 1902, to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 1 | 2.80 | 120 | 4.30 | 632 | 6.40 | 1,690 |
| 1.40 | 3 | 2.90 | 138 | 4.40 | 676 | 6.60 | 1,800 |
| 1.50 | 7 | 3.00 | 159 | 4.50 | 720 | 6.80 | 1,910 |
| 1.60 | 11 | 3.10 | 183 | 4.60 | 765 | 7.00 | 2,030 |
| 1.70 | 15 | 3.20 | 210 | 4.70 | 810 | 7.20 | 2,150 |
| 1.80 | 20 | 3.30 | 240 | 4.80 | 855 | 7.40 | 2,270 |
| 1.90 | 25 | 3.40 | 273 | 4.90 | 900 | 7.60 | 2,390 |
| 2.00 | 31 | 3.50 | 309 | 5.00 | 950 | 7.80 | 2,510 |
| 2.10 | 38 | 3.60 | 347 | 5.20 | 1,050 | 8.00 | 2,630 |
| 2.20 | 46 | 3.70 | 386 | 5.40 | 1,150 | 8.50 | 2,950 |
| 2.30 | 55 | 3.80 | 425 | 5.60 | 1,250 | 9.00 | 3,300 |
| 2.40 | 65 | 3.90 | 465 | 5.80 | 1,360 | 9.50 | 3,650 |
| 2.50 | 76 | 4.00 | 506 | 6.00 | 1,470 | 10.00 | 4,000 |
| 2.60 | 89 | 4.10 | 547 | 6.20 | 1,580 | | |
| 2.70 | 104 | 4.20 | 589 | | | | |

The above table is applicable only for open-channel conditions. It is based upon 14 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1.3 feet and 4.1 feet. The curve above gage height 4.1 feet is determined by one measurement at gage height 6.55 feet.

*Estimated monthly discharge of Canadian River (North Fork) near El Reno, Okla., for 1902, 1903, and 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| **1902.** | | | | |
| October 27–31 | 31 | 31 | 31 | ..... |
| November | 291 | 31 | 67.6 | 4,022 |
| December | 120 | 65 | 88.3 | 5,429 |
| **1903.** | | | | |
| January | 159 | 76 | 128 | 7,870 |
| February | 347 | 120 | 157 | 8,719 |
| March | 1,050 | 183 | 464 | 28,530 |
| April | 347 | 120 | 207 | 12,320 |
| May | 3,510 | 159 | 1,196 | 73,540 |
| June | 1,150 | 210 | 487 | 28,980 |
| July 26 days [a] | 309 | 20 | 72.7 | 3,749 |
| August [b] | 138 | 7 | 28.9 | 1,777 |
| September | 11 | 0 | 3.37 | 201 |
| October | 11 | 0 | 1.77 | 109 |
| November | 7 | 1 | 2.47 | 147 |
| December | 25 | 1 | 10.3 | 633 |
| The period | 3,510 | 0 | ..... | 166,600 |
| **1904.** | | | | |
| January [c] | 46 | 20 | 30.1 | 1,851 |
| February | 55 | 31 | 46.3 | 2,663 |
| March | 55 | 31 | 39.4 | 2,423 |
| April | 506 | 20 | 63.2 | 3,761 |
| May | 3,230 | 55 | 622 | 38,240 |
| June | 2,000 | 104 | 530 | 31,540 |
| July | 4,000 | 120 | 1,421 | 87,370 |
| August | 855 | 183 | 381 | 23,430 |
| September | 159 | 55 | 101 | 6,010 |
| October | 1,250 | 55 | 176 | 10,820 |
| November | 104 | 89 | 92.5 | 5,504 |
| December | 240 | 76 | 122 | 7,501 |
| The year | 4,000 | 20 | 302 | 221,100 |

[a] Gage out 5 days in July.
[b] Discharge interpolated August 2 to 10.
[c] River partly frozen during January. Rating table applied as for open channel.

## GREER SPRING AT GREER, MO.

Greer Spring is located in the north-central part of Oregon County, 1½ miles south of Eleven Point River, near the town of Greer. Ordinarily it derives one-fourth of its water supply from an underground stream emerging from a cave in a high limestone bluff; the remainder from the so-called "boil," 100 feet distant and 7 feet lower, the source of which is unknown. The whole rises at the head of a deep and narrow valley, and flows in rapid descent to Eleven Point River, a distance of 1½ miles. On September 30, 1904, levels were run from the cave exit of the spring to Eleven Point River, and an almost uniform fall of 53.94 feet was found. There are numerous points at which dams could be built, affording solid rock for foundations and abutment, with plenty of material for building close at hand. There is at present a stone and timber dam, developing a fall of 9 feet and transmitting the power to a gristmill above the valley. On August 9, 1904, a gage was established by F. W. Hanna. Bench mark No. 1 is the top of a staple in a large root on the upstream side of a walnut tree, 10 feet upstream from left end of footbridge, which is 100 feet below the present dam. Its elevation is 9.96 feet above gage datum. Bench mark No. 2 is the top surface of the support of the right end of the footbridge, 1½ feet from the downstream end on the right side. Its elevation is 3.93 feet above gage datum.

The observations at this station during 1904 have been made under the direction of E. Johnson, jr., district hydrographer.

*Discharge measurements of Greer Spring at Greer, Mo., in 1904.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| August 29 | F. W. Hanna | 1.00 | 362 |
| October 1 | Johnson and Hanna | .72 | 265 |

*Mean daily gage height, in feet, of Greer Spring at Greer, Mo., for 1904.*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 0.95 | ..... | 0.65 | 0.60 | 17 | 1.00 | ..... | 0.65 | 0.60 | 0.60 |
| 2 | ..... | .95 | ..... | .65 | .60 | 18 | 1.00 | ..... | .65 | .60 | .60 |
| 3 | ..... | .95 | ..... | .65 | .60 | 19 | 1.00 | ..... | .65 | .60 | .60 |
| 4 | ..... | .95 | ..... | .65 | .60 | 20 | 1.00 | ..... | .65 | .60 | .60 |
| 5 | ..... | .95 | ..... | .60 | .60 | 21 | 1.00 | ..... | .65 | .60 | .60 |
| 6 | ..... | .95 | ..... | .60 | .60 | 22 | 1.00 | ..... | .65 | .60 | .60 |
| 7 | ..... | .95 | ..... | .60 | .60 | 23 | 1.00 | ..... | .65 | .60 | .60 |
| 8 | ..... | .95 | ..... | .60 | .60 | 24 | 1.00 | ..... | ..... | .60 | .60 |
| 9 | ..... | .95 | ..... | .60 | .60 | 25 | 1.00 | ..... | ..... | .60 | .60 |
| 10 | 1.00 | .95 | ..... | .60 | .60 | 26 | 1.00 | ..... | ..... | .60 | .60 |
| 11 | 1.00 | ..... | ..... | .60 | .60 | 27 | 1.00 | ..... | ..... | .60 | .60 |
| 12 | 1.00 | ..... | ..... | .60 | .60 | 28 | 1.00 | ..... | ..... | .60 | .60 |
| 13 | 1.00 | ..... | 0.70 | .60 | .60 | 29 | .95 | ..... | .65 | .60 | .60 |
| 14 | 1.00 | ..... | .70 | .60 | .60 | 30 | .95 | ..... | .65 | .60 | .60 |
| 15 | 1.00 | ..... | .70 | .60 | .60 | 31 | .95 | ..... | .65 | ..... | .60 |
| 16 | 1.00 | ..... | .65 | .60 | .60 | | | | | | |

## MISCELLANEOUS MEASUREMENTS IN ARKANSAS RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Arkansas River drainage basin in 1904 under the direction of the State engineer:

*Discharge measurements of Arkansas River at Canyon City, Colo., in 1904.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Second-feet.* |
| March 16 | A. A. Weiland | 4.00 | 496 |
| March 19 | do | 3.37 | 203 |
| April 14 | do | 3.72 | 378 |
| April 18 | do | 4.20 | 611 |
| April 18 | do | 4.07 | 578 |
| April 25 | do | 4.03 | 494 |
| April 26 | do | 3.60 | 275 |
| May 16 | do | 4.00 | 496 |
| May 18 | do | 4.48 | 799 |
| June 7 | do | 4.80 | 965 |
| June 10 | do | 5.20 | 1,307 |
| June 29 | do | 4.80 | 924 |
| June 29 | do | 4.26 | 569 |

*Discharge measurements of Arkansas River at Pueblo, Colo., in 1904.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Second-feet.* |
| March 25 | A. Jones | 1.70 | 97 |
| April 7 | do | 1.97 | 216 |
| April 12 | A. A. Weiland | 2.15 | 87 |
| April 18 | A. Jones | 2.60 | 468 |
| May 4 | A. A. Weiland | 2.68 | 745 |
| May 9 | A. Jones | 2.89 | 792 |
| May 15 | do | 3.50 | 1,554 |
| May 26 | do | 3.70 | 2,178 |
| May 31 | do | 3.43 | 1,677 |
| June 7 | do | 2.98 | 1,040 |
| June 9 | do | 3.73 | 2,091 |
| July 1 | A. A. Weiland | 3.39 | 1,620 |
| August 17 | do | 3.50 | 1,910 |
| August 27 | do | 2.94 | 1,004 |
| September 16 | do | 2.19 | 354 |
| September 26 | do | 2.24 | 359 |

*Discharge measurements of Arkansas River at Nepesta, Colo., in 1904.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Ft. per sec.* | *Feet.* | *Second-feet.* |
| March 14 | A. Jones | 72 | 1.49 | 0.49 | 107 |
| April 11 | do | 70 | 1.64 | .40 | 115 |
| May 4 | A. A. Weiland | 467 | 2.55 | 1.10 | 1,193 |
| May 18 | A. Jones | 345 | 3.00 | 1.02 | 1,024 |
| June 6 | do | 779 | 2.62 | 1.40 | 2,067 |

*Discharge measurements of Arkansas River at La Junta, Colo., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| March 31 | A. Jones | 40 | 28 | 1.28 | 1.51 | 36 |
| May 10 | do | 145 | 419 | .89 | 2.40 | 370 |
| May 16 | do | 97 | 180 | 2.49 | 2.70 | 449 |
| May 23 | do | 143 | 344 | 1.47 | 2.55 | 505 |
| June 1 | do | 158 | 239 | 2.23 | 2.63 | 534 |

*Discharge measurements of Arkansas River at Prowers, Colo., in 1904.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Ft. per sec.* | *Feet.* | *Second-feet.* |
| May 6 | A. Jones | 711 | 1.86 | 0.87 | 1,319 |
| May 22 | do | 2,127 | 4.70 | 2.90 | 10,000 |

*Measurements in Cimarron River drainage basin in 1904.*

[By L. M. Holt and Claud Fisher.]

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Sec.-ft.* |
| Mar. 20 | Cimarron River | Kenton, Okla | 2 | 1.12 | 1.2 | 1.38 |
| Mar. 23 | do | do | 2 | 1.12 | 1.4 | 1.6 |
| Mar. 30 | Colonel Perry's irrigation ditch | Englewood, Kans | 4.4 | 6.07 | 1.7 | 10.7 |
| Mar. 31 | Cimarron River | Coin, Okla | 56 | 47 | 1.8 | 84 |

*Measurements in Canadian River drainage basin in 1904.*

[By Elmas R. Kerby.]

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Sec.-ft.* |
| Jan. 23 | Canadian River | Union City, Okla | 45 | 34 | 1.10 | 38 |
| June 7 | do | do | 219 | 304 | 1.55 | 472 |
| Oct. 16 | do | do | 1,240 | 3,414 | 2.64 | 9,009 |
| Jan. 23 | Deer Creek | Hydro, Okla | 20 | 16 | 1.32 | 22 |
| May 4 | do | do | 23 | 37 | 2.29 | 85 |
| June 8 | do | do | 24 | 21 | 1.49 | 31 |

*Measurements in Arkansas River drainage basin in 1904.*

[By M. R. Hall and assistants.]

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 27 | White River | Near Newport, Ark | 472 | 12,870 | 3.24 | 16.7 | 41,630 |

NOTE.—Measured at Iron Mountain Railroad bridge, about 2 miles southwest of Newport. Gage height from United States Weather Bureau gage.

## RED RIVER DRAINAGE BASIN.

The headwaters of Red River include several forks, all of which have their sources in northern Texas. Red River takes a general easterly direction along the northern boundary of Texas, and then turns toward the southeast and flows through a low, swampy region in Louisiana into the Mississippi, not far from the southern boundary of Mississippi. Washita River rises in northern Texas, crosses southern Oklahoma, and flows into Red River in the southern part of Indian Territory, about 10 miles from Denison, Tex.

Sulphur Fork of Red River has its headwaters in Hunt and Fannin counties, Tex., flows eastward, forming the boundary between Delta, Red River, and Bowie counties on the north, and Hopkins, Franklin, Titus, Morris, and Cass counties on the south, and empties into Red River in Arkansas about 7 miles north of the boundary line between that State and Louisiana. The flow of this river is very unreliable, changing with the rainfall. If the summer is at all dry it ceases to flow altogether, but there always remains enough water standing in pools to water stock. During or immediately after protracted or unusually heavy rains the river becomes very wide and deep, floods its bottoms, and often occasions considerable loss of stock and damage to planters and the railroads.

Big Cypress River has its headwaters in Franklin and Titus counties, Tex., flows in a general easterly direction, and empties into Red River. The flow of the river is unreliable, varying with the rainfall. In the summer it ceases to flow, becoming dry, except in those places where the water stands in holes. After long or heavy rains the stream is liable to overflow its banks.

### RED RIVER (NORTH FORK) NEAR GRANITE, OKLA.

This station was established June 23, 1903, by Ferd. Bonstedt. It is located at the highway bridge 2 miles east and one-half mile north of Granite, Okla. The Chicago, Rock Island and Pacific Railroad crosses the river near this point. The gage is of the wire type and is located on the downstream side of the bridge near the west end. The length from the bottom of the weight to the marker is 20.32 feet. The marker reads 17.00 feet when the weight is pulled up against the bottom of the bridge. The gage is read daily by Elmer O. Tompkins. Discharge measurements are made from the bridge. The channel is straight for about 500 feet above the station and for about 300 feet below. Both banks are subject to overflow at flood stages. The bed of the stream is sandy and shifting. The water flows in three channels at low water. The gage is referred to a United States Geological Survey standard iron bench mark which is 292 feet east of the bridge

near the south line of the highway. Its elevation above gage datum is 10.64 feet and above sea level 1,539.8 feet.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

*Discharge measurements of Red River (North Fork) near Granite, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Second-feet.* |
| May 6 | E. R. Kerby | 120 | 171 | 1.35 | 4.90 | 231 |
| May 26 | do | 2 | 0.4 | 0.30 | 3.50 | .12 |
| June 9 | do | 281 | 1,081 | 1.91 | 6.20 | 2,062 |
| July 13 | do | 32 | 34 | 1.54 | 5.10 | 49 |
| August 30 | do | | | | | [a] .0 |
| September 22 | do | | | | | [a] .0 |
| October 21 | do | | | | | [a] .0 |

[a] Water standing in pools.

*Mean daily gage height, in feet, Red River (North Fork) near Granite, Okla., for 1904.*

| Day. | May. | June. | July. | Aug. | Day. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 4.5 | 5.0 | | 17 | 4.1 | 4.7 | 4.7 | |
| 2 | | 4.3 | 5.0 | | 18 | 4.0 | 4.5 | 4.6 | |
| 3 | 6.6 | 4.3 | 4.8 | | 19 | 3.9 | 4.5 | 4.5 | |
| 4 | 7.0 | 4.0 | 6.5 | | 20 | 3.9 | 4.4 | 4.5 | |
| 5 | 5.5 | 3.9 | 6.0 | 5.2 | 21 | 3.8 | 7.8 | 4.5 | |
| 6 | 4.9 | 4.1 | 5.7 | 5.6 | 22 | 3.8 | 5.8 | 4.5 | |
| 7 | 4.6 | 4.3 | 5.5 | 5.5 | 23 | 3.7 | 5.2 | 4.5 | |
| 8 | 4.5 | 4.1 | 5.5 | 5.4 | 24 | 3.6 | 6.0 | 4.5 | |
| 9 | 4.5 | 7.2 | 5.5 | 5.1 | 25 | 3.6 | 5.0 | 4.5 | |
| 10 | 4.4 | 6.4 | | 5.1 | 26 | 3.5 | 5.5 | | |
| 11 | | 6.0 | | 4.8 | 27 | 3.6 | 5.5 | | |
| 12 | 4.3 | 6.8 | 5.2 | 4.7 | 28 | 3.9 | 5.4 | | |
| 13 | 4.3 | 5.1 | 5.1 | 4.6 | 29 | 4.0 | 5.2 | | |
| 14 | 4.3 | 5.0 | 5.0 | | 30 | 5.1 | 5.1 | | |
| 15 | 4.2 | 4.9 | 4.9 | | 31 | 4.7 | | | |
| 16 | 4.1 | 4.8 | 4.8 | | | | | | |

NOTE.—No discharge except on days when gage heights are given.

## ELK CREEK NEAR HOBART, OKLA.

This station was established September 22, 1904, by Elmas R. Kerby. It is located about 3 miles southwest of Hobart, Okla., 300 feet north of public highway running west, and 450 feet upstream from a small temporary bridge across the creek. The gage is a plain staff, graduated to feet and tenths, fastened to a large cottonwood tree on the right bank. The gage is read once each day by A. P. Lockhart. Discharge measurements are made at low stages by wading 100 feet

below the gage. During high water, measurements are made from the bridge. A permanent bridge is to replace the temporary one, so no initial point for soundings has been selected. The channel is straight for about 100 feet above and below the station. The current varies, being swift in some places and sluggish in others. Both banks are high and wooded. The bed of the stream is free from vegetation, and is permanent. There is but one channel at all stages. The bench mark is a screw in the base of a large cottonwood tree on the left bank of the stream about 80 feet south of the gage. The tree is blazed on the east and south sides, and located about 120 feet north from the center of the public highway. The elevation of the bench mark is 17.23 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

*Discharge measurements of Elk Creek near Hobart, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| September 22 | Gordon and Kerby | 6.4 | 2.9 | 0.61 | 0.90 | 1.8 |
| October 21 | Kerby and Johnson | 7.3 | 4.3 | .69 | .95 | 3.0 |

*Mean daily gage height, in feet, of Elk Creek near Hobart, Okla., for 1904.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ..... | 0.9 | 1.0 | 1.8 | 17 | ..... | 1.1 | 1.5 | 1.8 |
| 2 | ..... | .9 | 1.0 | 1.8 | 18 | ..... | 1.1 | 1.5 | 1.8 |
| 3 | ..... | .9 | 1.0 | 1.8 | 19 | ..... | .9 | 1.5 | 1.9 |
| 4 | ..... | .9 | 1.0 | 1.8 | 20 | ..... | .9 | 1.5 | 1.9 |
| 5 | ..... | .9 | 1.0 | 1.5 | 21 | ..... | .9 | 1.5 | 1.9 |
| 6 | ..... | .9 | 1.0 | 1.5 | 22 | 0.9 | .9 | 1.6 | 2.0 |
| 7 | ..... | .9 | 1.0 | 1.5 | 23 | 1.0 | .9 | 1.7 | 2.0 |
| 8 | ..... | .9 | 1.0 | 1.6 | 24 | 1.0 | .9 | 1.7 | 1.9 |
| 9 | ..... | .9 | 1.0 | 1.6 | 25 | 1.0 | .9 | 1.7 | 1.9 |
| 10 | ..... | .9 | 1.0 | 1.7 | 26 | 1.0 | .9 | 1.7 | 1.9 |
| 11 | ..... | .9 | 1.1 | 1.8 | 27 | .9 | .9 | 1.7 | 1.9 |
| 12 | ..... | .9 | 1.2 | 1.8 | 28 | .9 | .9 | 1.7 | 1.9 |
| 13 | ..... | .9 | 1.3 | 1.8 | 29 | .9 | .9 | 1.8 | 1.9 |
| 14 | ..... | 1.3 | 1.4 | 1.9 | 30 | .9 | .9 | 1.8 | 1.9 |
| 15 | ..... | .9 | 1.5 | 1.9 | 31 | ..... | .9 | ..... | 1.9 |
| 16 | ..... | 1.5 | 1.5 | 1.8 | | | | | |

## OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 2, 1903, by G. H. Matthes. It is located on G. M. Dale's homestead, SE. ¼, sec. 21, T. 3 N., R. 17 W., Indian meridian. It is 2 miles west and 1 mile north of Mountain Park, Okla. The gage consists of a 2 by 6 inch board, 26 feet long, bolted to a cottonwood tree, which stands at the water's edge. It is graduated to feet and tenths and marked with brass figures. The gage is read daily by G. M. Dale. The channel is slightly curved both above and below the station. Both banks are about 20 feet high, of sandy loam, covered with vegetation, and subject to overflow. The bed of the stream is of sand, and is liable to shift. The water flows in one channel at normal stages, but when about to overflow its banks part of the water is diverted through a slough into Horse Creek. Measurements of discharge are made by wading, as there are no bridges in this locality. Bench mark No. 1 is a 20-penny nail driven into the cottonwood tree to which the gage is attached. It is at the elevation of the 10-foot mark on the gage. Bench mark No. 2 is a nail driven into a mesquite tree 150 feet southwest of G. M. Dale's house. It is 28.62 feet above the zero of the gage. Bench mark No. 3 is a nail driven into a hackberry tree 50 feet east of the creek and 20 feet north of the gage. It is 8.94 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

*Discharge measurements of Otter Creek near Mountain Park, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| April 9 | L. M. Holt | 4 | 1.2 | 1.22 | 1.20 | 1.5 |
| May 7 | E. R. Kerby | 11 | 4.4 | .58 | 1.10 | 2.5 |
| May 27 | do | 1 | .1 | 1.00 | .90 | .1 |
| July 14 | do | 1 | .1 | 1.00 | .90 | .1 |
| August 28 | do | | | | .90 | [a] 0 |
| September 23 | do | | | | .90 | [a] 0 |
| October 22 | do | | | | .90 | [a] 0 |

[a] Water standing in pools.

*Mean daily gage height, in feet, of Otter Creek near Mountain Park, Okla., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 1.4 | 1.2 | 1.2 | 1.0 | 0.9 | 1.2 | 0.8 | 0.9 | 0.9 | .9 | 0.9 |
| 2 | 1.4 | 1.4 | 1.2 | 1.2 | 1.0 | .9 | 1.1 | 1.1 | .9 | .9 | .9 | .9 |
| 3 | 1.4 | 1.4 | 1.2 | 1.2 | 1.2 | 3.0 | 1.0 | 1.1 | .9 | .9 | .9 | .9 |
| 4 | 1.4 | 1.4 | 1.2 | 1.2 | 1.4 | 1.4 | 1.0 | .9 | .9 | .9 | .9 | .9 |
| 5 | 1.4 | 1.3 | 1.2 | 1.5 | 1.3 | 1.2 | 1.0 | 3.2 | .9 | .9 | .9 | .9 |
| 6 | 1.4 | 1.3 | 1.2 | 1.2 | 1.2 | 1.1 | 1.0 | 2.1 | .9 | .9 | .9 | .9 |
| 7 | 1.4 | 1.3 | 1.3 | 1.3 | 1.1 | 1.0 | 1.1 | 3.6 | .9 | .9 | .9 | .9 |
| 8 | 1.4 | 1.3 | 1.3 | 1.2 | 1.1 | 1.0 | 1.1 | 2.0 | .9 | .9 | .9 | .9 |
| 9 | 1.4 | 1.3 | 1.3 | 1.2 | 1.0 | 3.3 | 1.0 | 1.5 | .9 | .9 | .9 | .9 |
| 10 | 1.4 | 1.3 | 1.3 | 1.2 | 1.0 | 9.2 | 1.0 | 1.3 | .9 | .9 | .9 | .9 |
| 11 | 1.4 | 1.3 | 1.2 | 1.2 | 1.0 | 2.4 | 1.0 | 1.2 | .9 | .9 | .9 | .9 |
| 12 | 1.4 | 1.3 | 1.2 | 1.2 | 1.0 | 1.7 | .9 | 1.1 | .9 | .9 | .9 | .9 |
| 13 | 1.3 | 1.3 | 1.2 | 1.1 | 1.0 | 1.5 | .9 | 1.0 | .9 | .9 | .9 | .9 |
| 14 | 1.3 | 1.3 | 1.2 | 1.1 | 1.0 | 1.3 | .9 | 1.0 | .9 | .9 | .9 | .9 |
| 15 | 1.4 | 1.3 | 1.2 | 1.1 | 1.0 | 1.2 | .9 | 1.0 | .9 | .9 | .9 | .9 |
| 16 | 1.4 | 1.3 | 1.3 | 1.1 | 4.0 | 1.1 | .9 | .9 | .9 | .9 | .9 | .9 |
| 17 | 1.4 | 1.3 | 1.3 | 1.1 | 1.5 | 1.1 | .9 | .9 | .9 | .9 | .9 | .9 |
| 18 | 1.4 | 1.3 | 1.2 | 1.1 | 1.3 | 1.0 | .9 | .9 | .9 | .9 | .9 | .9 |
| 19 | 1.4 | 1.3 | 1.2 | 1.1 | 1.2 | 1.0 | .9 | .9 | .9 | .9 | 1.0 | .9 |
| 20 | 1.4 | 1.3 | 1.2 | 1.1 | 1.2 | 1.0 | .9 | .9 | .9 | .9 | 1.0 | .9 |
| 21 | 1.5 | 1.3 | 1.2 | 1.1 | 1.0 | 1.0 | 1.25 | .9 | .9 | .9 | 1.0 | .9 |
| 22 | 1.5 | 1.3 | 1.2 | 1.1 | 1.0 | 1.0 | 1.1 | .9 | .9 | .9 | 1.0 | .9 |
| 23 | 1.4 | 1.3 | 1.2 | 1.1 | 1.0 | 1.0 | 1.0 | .9 | .9 | .9 | 1.0 | .9 |
| 24 | 1.4 | 1.3 | 1.2 | 1.1 | .9 | 1.0 | .9 | .9 | .9 | .9 | 1.0 | .9 |
| 25 | 1.4 | 1.3 | 1.2 | 1.1 | .9 | 1.0 | .9 | .8 | .9 | .9 | 1.0 | .9 |
| 26 | 1.4 | 1.3 | 1.2 | 1.1 | .9 | 2.65 | .9 | .8 | .9 | .9 | 1.0 | .9 |
| 27 | 1.4 | 1.3 | 1.2 | 1.0 | .9 | 2.0 | .9 | .8 | .9 | .9 | 1.0 | .9 |
| 28 | 1.4 | 1.3 | 1.2 | 1.0 | .9 | 1.6 | .9 | .9 | .9 | .9 | 1.0 | .9 |
| 29 | 1.4 | 1.3 | 1.2 | 1.0 | 1.5 | 1.4 | .9 | .9 | .9 | .9 | 0.9 | .9 |
| 30 | 1.4 | ..... | 1.2 | 1.0 | 1.3 | 1.3 | .9 | .9 | .9 | .9 | 0.9 | .9 |
| 31 | 1.4 | ..... | 1.2 | ..... | 1.0 | ..... | .9 | .9 | ..... | .9 | ..... | .9 |

*Estimated monthly discharge of Otter Creek near Mountain Park, Okla., for 1904.*

[Drainage area, 126 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 3 | 2.0 | 2.50 | 154 | 0.020 | 0.023 |
| February | 2.5 | 2.0 | 2.07 | 118 | .016 | .017 |
| March | 2 | 1.5 | 1.60 | 98 | .013 | .015 |
| April | 3 | 1.0 | 1.35 | 80 | .011 | .012 |
| May | 188 | .5 | 8.45 | 520 | .067 | .077 |
| June | 780 | .1 | 40.1 | 2,386 | .318 | .355 |
| July | 1.8 | 0 | .40 | 25 | .0032 | .0037 |
| August | 152 | 0 | 11.3 | 695 | .090 | .104 |
| September | 0 | 0 | 0 | 0 | 0 | 0 |
| October | 0 | 0 | 0 | 0 | 0 | 0 |
| November | 0 | 0 | 0 | 0 | 0 | 0 |
| December | 0 | 0 | 0 | 0 | 0 | 0 |
| The year | 780 | 0 | 5.65 | 4,076 | .045 | .607 |

NOTE.—The monthly estimates are an approximation based on the 1903 rating tables and interpolation between the 1904 measurements.

## WASHITA RIVER AT ANADARKO, OKLA.

This station, established October 25, 1902, by W. G. Russell, is located at the highway bridge one-half mile north of the Anadarko railroad depot. The gage is of the wire type, with the scaleboard graduated to feet and tenths, and spiked to the hand rail of the bridge. The initial point for soundings is on the right bank. The channel both above and below the station is straight for 200 feet; the right bank is high and the left bank is low; both banks are liable to overflow; the bed of the stream is sandy and constant. The observer is James H. Dunlap, who reads the gage once each day.

The observations at this station during 1904 have been made under the direction of G. H. Matthes, district engineer.

*Discharge measurements of Washita River at Anadarko, Okla., in 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| January 23 | E. R. Kerby | 65 | 108 | 1.24 | 3.40 | 134 |
| May 3 | do | 70 | 308 | 1.84 | 5.40 | 566 |
| May 25 | do | 68 | 147 | 2.16 | 3.60 | 318 |
| June 6 | do | 72 | 287 | 1.79 | 5.10 | 513 |
| July 12 | do | 73 | 909 | 3.12 | 13.60 | 2,850 |
| July 23 | do | 70 | 220 | 2.12 | 4.60 | 466 |
| August 30 | do | 76 | 148 | 1.28 | 3.30 | 190 |
| September 20 | do | 63 | 92 | 1.16 | 2.70 | 94 |
| October 19 | do | 56 | 96 | .69 | 2.50 | 76 |

*Mean daily gage height, in feet, of Washita River at Anadarko, Okla., for 1904.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 3.3 | 3.3 | 3.2 | 5.8 | 4.0 | 4.1 | 3.9 | 3.0 | 2.5 | 2.3 | 2.5 |
| 2 | 3.3 | 3.3 | 3.3 | 3.2 | 6.1 | 4.4 | 3.7 | 3.8 | 2.9 | 2.4 | 2.3 | 2.5 |
| 3 | 3.3 | 3.3 | 3.3 | 3.2 | 5.4 | 5.0 | 3.5 | 4.1 | 2.8 | 2.4 | 2.3 | 2.5 |
| 4 | 3.3 | 3.3 | 3.3 | 3.2 | 4.9 | 4.7 | 3.4 | 4.3 | 2.8 | 2.4 | 2.3 | 2.5 |
| 5 | 3.3 | 3.3 | 3.3 | 3.3 | 4.1 | 7.1 | 3.1 | 4.7 | 2.8 | 2.4 | 2.3 | 2.5 |
| 6 | 3.3 | 3.3 | 3.3 | 3.3 | 6.8 | 5.1 | 3.1 | 5.9 | 2.8 | 2.4 | 2.3 | 2.5 |
| 7 | 3.3 | 3.3 | 3.3 | 3.4 | 9.6 | 4.9 | 3.1 | 8.9 | 2.8 | 2.4 | 2.3 | 2.5 |
| 8 | 3.3 | 3.3 | 3.3 | 3.4 | 10.1 | 4.6 | 3.1 | 6.4 | 2.8 | 2.4 | 2.4 | 2.5 |
| 9 | 3.3 | 3.3 | 3.3 | 3.4 | 5.9 | 5.6 | 3.1 | 5.9 | 2.8 | 2.4 | 2.4 | 2.5 |
| 10 | 3.3 | 3.3 | 3.3 | 3.3 | 5.6 | 5.3 | 9.7 | 4.1 | 2.8 | 2.4 | 2.4 | 2.5 |
| 11 | 3.3 | 3.3 | 3.3 | 3.3 | 5.0 | 7.6 | 12.2 | 4.6 | 2.8 | 2.4 | 2.4 | 2.5 |
| 12 | 3.3 | 3.3 | 3.3 | 3.2 | 4.7 | 9.6 | 13.6 | 4.2 | 2.8 | 2.4 | 2.4 | 2.5 |
| 13 | 3.3 | 3.3 | 3.3 | 3.2 | 4.2 | 10.4 | 14.1 | 4.0 | 2.8 | 2.3 | 2.4 | 2.5 |
| 14 | 3.3 | 3.3 | 3.2 | 3.2 | 3.9 | 9.7 | 14.6 | 3.9 | 2.7 | 2.3 | 2.4 | 2.5 |
| 15 | 3.3 | 3.3 | 3.2 | 3.2 | 3.7 | 6.8 | 13.1 | 3.8 | 2.7 | 2.3 | 2.4 | 2.5 |
| 16 | 3.3 | 3.3 | 3.2 | 3.2 | 4.8 | 5.6 | 7.8 | 3.8 | 2.7 | 2.4 | 2.4 | 2.5 |
| 17 | 3.3 | 3.3 | 3.2 | 3.2 | 5.7 | 4.7 | 6.4 | 3.7 | 2.7 | 2.4 | 2.4 | 2.5 |
| 18 | 3.3 | 3.3 | 3.2 | 3.2 | 7.3 | 4.2 | 6.0 | 3.6 | 2.7 | 2.4 | 2.4 | 2.8 |
| 19 | 3.3 | 3.3 | 3.2 | 3.2 | 7.6 | 4.0 | 5.5 | 3.5 | 2.7 | 2.5 | 2.4 | 2.5 |
| 20 | 3.3 | 3.3 | 3.2 | 3.2 | 6.8 | 3.9 | 5.2 | 3.4 | 2.7 | 2.4 | 2.4 | 2.6 |
| 21 | 3.5 | 3.3 | 3.2 | 3.2 | 4.9 | 3.8 | 4.9 | 3.4 | 2.6 | 2.4 | 2.4 | 2.6 |
| 22 | 3.4 | 3.3 | 3.2 | 3.3 | 4.3 | 3.6 | 4.7 | 3.3 | 2.6 | 2.4 | 2.5 | 2.6 |
| 23 | 3.4 | 3.3 | 3.2 | 3.4 | 3.9 | 3.5 | 4.6 | 3.2 | 2.6 | 2.3 | 2.5 | 2.6 |
| 24 | 3.4 | 3.3 | 3.2 | 3.4 | 4.6 | 3.4 | 4.5 | 3.1 | 2.6 | 2.3 | 2.5 | 2.6 |
| 25 | 3.4 | 3.3 | 3.2 | 3.4 | 3.6 | 3.3 | 4.6 | 3.1 | 2.6 | 2.3 | 2.5 | 2.6 |
| 26 | 3.4 | 3.3 | 3.2 | 3.4 | 3.5 | 3.6 | 4.7 | 3.1 | 2.6 | 2.3 | 2.5 | 2.6 |
| 27 | 3.4 | 3.3 | 3.2 | 3.6 | 3.2 | 4.3 | 4.9 | 3.2 | 2.6 | 2.3 | 2.5 | 2.6 |
| 28 | 3.3 | 3.3 | 3.2 | 5.1 | 3.2 | 4.7 | 4.4 | 3.1 | 2.5 | 2.3 | 2.5 | 2.6 |
| 29 | 3.3 | 3.3 | 3.2 | 4.9 | 3.2 | 5.9 | 4.2 | 3.1 | 2.5 | 2.3 | 2.5 | 2.6 |
| 30 | 3.3 | ..... | 3.2 | 4.1 | 3.2 | 4.9 | 4.0 | 3.3 | 2.5 | 2.3 | 2.5 | 2.6 |
| 31 | 3.3 | ..... | 3.2 | ..... | 3.3 | ..... | 4.0 | 3.0 | ..... | 2.3 | ..... | 2.6 |

*Estimated monthly discharge of Washita River at Anadarko, Okla., 1902–1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| **1902.** | | | | |
| October 25–31 | 170 | 170 | 170 | 2,360 |
| November | 1,500 | 165 | 395 | 23,500 |
| December | 1,000 | 225 | 330 | 20,290 |
| **1903.** | | | | |
| January | 205 | 160 | 177 | 10,880 |
| February | 1,920 | 140 | 312 | 17,330 |
| March | 2,760 | 311 | 666 | 40,950 |
| April | 551 | 228 | 314 | 18,680 |
| May | 7,500 | 311 | 1,815 | 111,600 |
| June | 3,110 | 699 | 1,210 | 72,000 |
| July | 720 | 230 | 376 | 23,120 |
| August | 220 | 95 | 159 | 9,777 |
| September | 94 | 55 | 70.3 | 4,183 |
| October | 82 | 65 | 75.0 | 4,612 |
| November | 103 | 73 | 88.4 | 5,260 |
| December | 105 | 92 | 101 | 6,210 |
| The year | 7,500 | 55 | 447 | 324,600 |
| **1904.** | | | | |
| January | 147 | 103 | 119 | 7,317 |
| February | 117 | 117 | 117 | 6,730 |
| March | 117 | 102 | 108 | 6,641 |
| April | 511 | 102 | 148 | 8,807 |
| May | 1,766 | 215 | 569 | 34,990 |
| June | 1,856 | 196 | 588 | 34,990 |
| July | 3,180 | 164 | 792 | 48,700 |
| August | 1,420 | 148 | 335 | 20,600 |
| September | 148 | 74 | 105 | 6,248 |
| October | 76 | 46 | 55.5 | 3,413 |
| November | 74 | 46 | 60.9 | 3,624 |
| December | 118 | 74 | 80.8 | 4,968 |
| The year | 3,180 | 46 | 257 | 187,000 |

NOTE.—Discharges for 1902, 1903, and 1904 applied indirectly, taking into account periodic changes in channel between flood crests.

## OUACHITA RIVER NEAR MALVERN, ARK.

This station is located at the fall line on the river, at the Rockport Bridge, 1¾ miles northwest of Malvern, Ark. The vertical gage, which is fastened to the web between the cylinders of the first pier from the left bank, was installed March 3, 1903, by the General Bauxite Company. It is read once daily by A. M. Baker. Discharge measurements are made from a three-span iron highway bridge 500 feet long and from 30 feet of trestle approach on the right bank, and the first was made by J. M. Giles, May 15, 1903, at which date bench marks were established. The initial point for soundings is the end of the iron bridge on the downstream side at the left bank. The channel is straight for 1,000 feet above and 800 feet below the station. The right bank is high and wooded and overflows only during extreme floods. The left bank does not overflow. The bed of the stream is composed mainly of rock and is permanent. An old dam just below the bridge is the cause of the sluggish current at low water. At this stage, however, measurements can be made by wading at gaps in the dam, where a good velocity may be obtained. Bench mark No. 1 is the top of the first cylindrical pier from the left bank on the downstream side. Its elevation is 27.08 feet above the zero of the gage. Bench march No. 2 is a copper plug set in the northwest corner of the left concrete abutment. Its elevation is 26.23 feet above the zero of the gage. Bench mark No. 3 is the top of an eyebolt set in the solid rock about 25 feet south of the bridge, at a point 90 feet from the initial point for soundings. Its elevation is 11.86 feet above the zero of the gage.

The observations at this station during 1904 have been made under the direction of M. R. Hall, district hydrographer.

*Discharge measurements of Ouachita River near Malvern, Ark., in 1903 and 1904.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| 1903. | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| May 15 | J. M. Giles | | 2,471 | 1.77 | 5.60 | 4,395 |
| May 16 | do | | 2,252 | 1.53 | 5.00 | 3,455 |
| July 9 | do | | 421 | .40 | .65 | 171 |
| July 9 | do | | 172 | 1.15 | .65 | 198 |
| July 10 | do | | 177 | 1.37 | .80 | 243 |
| 1904. | | | | | | |
| April 25 | J. M. Giles | 480 | 5,734 | 3.09 | 12.30 | 17,700 |
| April 25 | do | 480 | 5,446 | 2.88 | 11.60 | 15,660 |
| April 26 | do | 470 | 4,019 | 2.20 | 8.45 | 8,849 |
| April 26 | do | 410 | 3,600 | 2.22 | 7.90 | 7,989 |

*Mean daily gage height, in feet, of Ouachita River near Malvern, Ark.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct.[a] | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.90 | 3.80 | 4.50 | 3.80 | 1.00 | 2.00 | 3.00 | 0.50 | ..... | ..... | 0.30 |
| 2 | 2.70 | 3.40 | 4.20 | 3.80 | 1.00 | 1.70 | 1.70 | .50 | ..... | ..... | .40 |
| 3 | 2.40 | 3.00 | 3.90 | 3.60 | 1.00 | 1.00 | 1.20 | 2.10 | ..... | ..... | .20 |
| 4 | 2.30 | 2.90 | 3.50 | 3.00 | .90 | 1.20 | 3.50 | 1.80 | ..... | ..... | .10 |
| 5 | 2.20 | 2.80 | 3.30 | 3.00 | 12.85 | 1.10 | 2.70 | 1.40 | ..... | ..... | .10 |
| 6 | 2.00 | 2.70 | 4.00 | 3.00 | 16.65 | 1.10 | 2.20 | 1.00 | ..... | ..... | .10 |
| 7 | 2.00 | 2.60 | 4.40 | 4.50 | 12.95 | 1.00 | 3.50 | .80 | ..... | ..... | .10 |
| 8 | 1.90 | 2.50 | 6.00 | 6.00 | 8.70 | 1.00 | 2.80 | .80 | ..... | ..... | .10 |
| 9 | 1.80 | 2.50 | 6.10 | 5.60 | 9.70 | 1.00 | 2.80 | .80 | ..... | ..... | .10 |
| 10 | 1.80 | 2.30 | 6.10 | 4.70 | 10.00 | 1.00 | 2.20 | .70 | ..... | ..... | .10 |
| 11 | 1.70 | 2.20 | 5.10 | 3.80 | 7.60 | 1.20 | 2.00 | .60 | ..... | ..... | .10 |
| 12 | 1.60 | 2.10 | 4.60 | 3.30 | 5.70 | 1.20 | 1.90 | .60 | ..... | ..... | .10 |
| 13 | 1.60 | 4.20 | 4.00 | 3.70 | 4.80 | 1.10 | 1.80 | .70 | ..... | ..... | .20 |
| 14 | 1.60 | 5.30 | 3.70 | 3.10 | 4.40 | 2.00 | 1.80 | .70 | ..... | ..... | .20 |
| 15 | 1.50 | 4.70 | 3.30 | 3.00 | 3.80 | 1.90 | 1.20 | .50 | ..... | ..... | .20 |
| 16 | 1.50 | 4.40 | 3.30 | 2.60 | 3.00 | 1.00 | 1.10 | .50 | ..... | ..... | .20 |
| 17 | 1.50 | 6.00 | 6.60 | 2.00 | 2.70 | 1.00 | 1.80 | .60 | ..... | ..... | .10 |
| 18 | 2.40 | 17.70 | 4.90 | 1.90 | 2.80 | 1.00 | 2.00 | .60 | ..... | ..... | .00 |
| 19 | 11.70 | 11.30 | 4.40 | 1.60 | 2.80 | 1.00 | 1.00 | .60 | ..... | ..... | .00 |
| 20 | 11.70 | 8.00 | 3.70 | 1.00 | 2.40 | 2.30 | 1.00 | .50 | ..... | ..... | .00 |
| 21 | 9.40 | 7.70 | 3.60 | 1.00 | 2.30 | 2.50 | .70 | .50 | ..... | 0.80 | .10 |
| 22 | 11.20 | 6.70 | 4.10 | 1.00 | 2.00 | 3.70 | .70 | .50 | ..... | 1.00 | .10 |
| 23 | 9.40 | 8.50 | 4.00 | 1.00 | 2.10 | 3.00 | .70 | .50 | ..... | 1.00 | .30 |
| 24 | 7.90 | 6.50 | 5.40 | 1.00 | 3.00 | 2.20 | .60 | .60 | ..... | .60 | .20 |
| 25 | 6.50 | 6.10 | 11.90 | 1.00 | 3.40 | 2.10 | .60 | .70 | ..... | .60 | .40 |
| 26 | 5.70 | 5.60 | 8.70 | 1.00 | 2.00 | 2.00 | .50 | .80 | ..... | .40 | 1.10 |
| 27 | 5.00 | 6.10 | 5.00 | 1.30 | 2.00 | 1.90 | .40 | .90 | ..... | .40 | 3.00 |
| 28 | 4.60 | 6.60 | 4.50 | 1.00 | 2.00 | 1.90 | .40 | .80 | ..... | .40 | 3.30 |
| 29 | 4.10 | 5.40 | 4.30 | 1.00 | 2.00 | 1.80 | .50 | 1.00 | ..... | .40 | 3.00 |
| 30 | ..... | 5.00 | 4.30 | 1.00 | 2.00 | 2.00 | .50 | 1.00 | ..... | .40 | 2.00 |
| 31 | ..... | 4.40 | ..... | 1.00 | ..... | [b]2.50 | .50 | ..... | ..... | ..... | 2.00 |

[a] Gage heights October 1 to November 20 omitted, owing to probable error. [b] Estimated.

*Rating table for Ouachita River near Malvern, Ark., from March 1, 1903, to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.00 | 40 | 1.70 | 590 | 3.40 | 1,800 | 6.20 | 5,140 |
| .10 | 60 | 1.80 | 640 | 3.50 | 1,900 | 6.40 | 5,430 |
| .20 | 80 | 1.90 | 700 | 3.60 | 2,000 | 6.60 | 5,730 |
| .30 | 105 | 2.00 | 760 | 3.70 | 2,100 | 6.80 | 6,050 |
| .40 | 130 | 2.10 | 820 | 3.80 | 2,200 | 7.00 | 6,380 |
| .50 | 155 | 2.20 | 880 | 3.90 | 2,300 | 7.50 | 7,230 |
| .60 | 180 | 2.30 | 940 | 4.00 | 2,400 | 8.00 | 8,100 |
| .70 | 210 | 2.40 | 1,000 | 4.20 | 2,600 | 8.50 | 9,050 |
| .80 | 240 | 2.50 | 1,070 | 4.40 | 2,820 | 9.00 | 10,050 |
| .90 | 270 | 2.60 | 1,140 | 4.60 | 3,050 | 9.50 | 11,090 |
| 1.00 | 300 | 2.70 | 1,220 | 4.80 | 3,290 | 10.00 | 12,160 |
| 1.10 | 335 | 2.80 | 1,300 | 5.00 | 3,530 | 10.50 | 13,270 |
| 1.20 | 370 | 2.90 | 1,380 | 5.20 | 3,770 | 11.00 | 14,440 |
| 1.30 | 410 | 3.00 | 1,460 | 5.40 | 4,020 | 11.50 | 15,650 |
| 1.40 | 450 | 3.10 | 1,540 | 5.60 | 4,300 | 12.00 | 16,900 |
| 1.50 | 495 | 3.20 | 1,620 | 5.80 | 4,580 | | |
| 1.60 | 540 | 3.30 | 1,710 | 6.00 | 4,860 | | |

The above table is applicable only for open-channel conditions. It is based upon 9 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 0.0 foot and 13 feet. The table has been extended beyond these limits. Above gage height 12 feet the rating curve is a tangent, the difference being 250 per tenth.

*Estimated monthly discharge of Ouachita River near Malvern, Ark., for 1903 and 1904.*

| Month. | Discharge in second-feet. | | |
|---|---|---|---|
| | Maximum. | Minimum. | Mean. |
| 1903. | | | |
| March 3–31 | 36,900 | 1,900 | 8,914 |
| April | 1,710 | 640 | 1,006 |
| May | 37,400 | 640 | 5,231 |
| June | 5,430 | 240 | 1,210 |
| July | 880 | 155 | 248 |
| August | 8,100 | 270 | 2,176 |
| September | 5,430 | 300 | 1,177 |
| October | 25,900 | 300 | 2,323 |
| November | 300 | 210 | 229 |
| December 1–26 | 1,620 | 210 | 386 |
| 1904. | | | |
| February | 16,150 | 495 | 3,780 |
| March | 31,150 | 820 | 4,694 |
| April | 16,650 | 1,710 | 3,637 |
| May | 4,860 | 300 | 1,300 |
| June | 28,520 | 270 | 4,571 |
| July | 2,100 | 300 | 630 |
| August | 1,900 | 130 | 617 |
| September | 820 | 155 | 248 |
| November 21–30 | 300 | 130 | 185 |
| December | 1,710 | 40 | 267 |

## MISCELLANEOUS MEASUREMENTS IN RED RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Red River drainage basin in 1904:

*Miscellaneous measurements in Red River drainage basin in 1904.*

[By Elmas R. Kerby and L. M. Holt.]

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Sec. feet.* |
| May 6 | Elk Creek | Hobart, Okla | 17 | 41 | 1.15 | 48 |
| June 9 | do | do | 48 | 428 | 2.14 | 918 |
| June 9 | Little Elk Creek | do | 18 | 36 | .80 | 29 |
| July 13 | Elk Creek | do | 15 | 24 | 1.19 | 29 |
| Aug. 29 | do | do | 6 | 3 | .72 | 2.2 |
| Apr. 6 | East Elk Creek | Salem, Okla | 5.4 | 4.2 | 1.00 | 4.2 |
| Apr. 22 | Cache Creek | Lawton, Okla | 14 | 6 | .42 | 2.5 |
| June 4 | do | do | 48 | 113 | 1.90 | 214 |
| June 10 | do | do | 114 | 1,457 | 3.08 | 4,492 |
| May 20 | do | do | 14 | 9.8 | 1.40 | 13.7 |
| Sept. 5 | do | do | 6.5 | 2.7 | .44 | 1.2 |
| May 16 | Medicine Creek | Fort Sill, Okla | 18 | 18 | 2.98 | 54 |
| June 4 | do | do | 19 | 9.5 | 1.16 | 11 |
| May 5 | Washita River | Clinton, Okla | 77 | 479 | 2.91 | 1,395 |
| Apr. 8 | do | Shelley, Okla | 45 | 36 | 1.18 | 42 |
| Apr. 7 | Boggy Creek | Bessie, Okla | 4 | 1.7 | 1.2 | 2 |
| May 5 | Calvary Creek | Cordell, Okla | 1 | 1.0 | 1.0 | 1 |
| May 5 | Boggy Creek | Bessie, Okla | 17 | 12 | 2.02 | 24 |

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